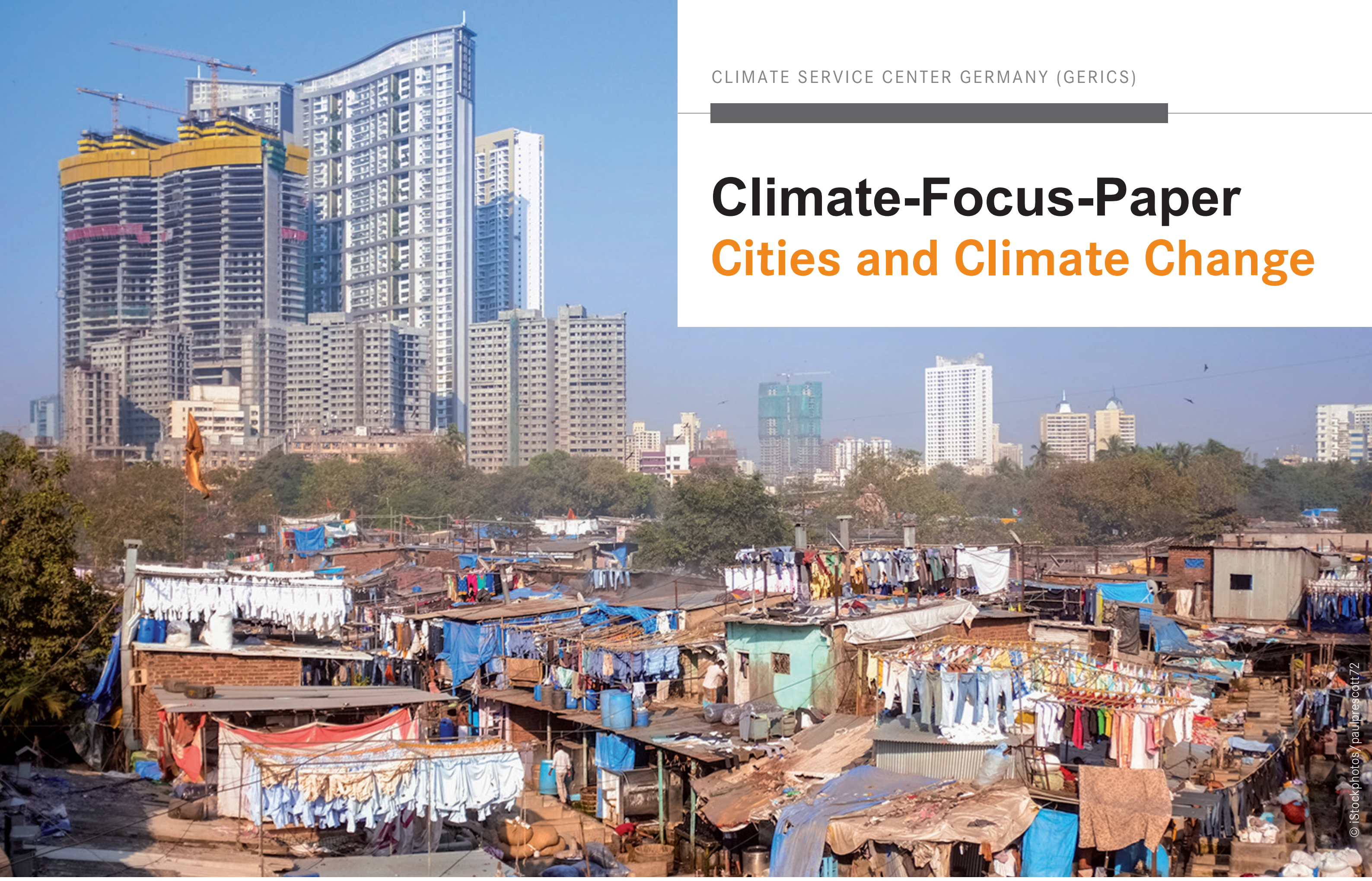

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# Climate-Focus-Paper
## Cities and Climate Change

### Speed read

- The majority of the world's population already lives in urban areas, and this trend will increase, with global urban population projected to have increased to 66% by 2050.
- Cities consume up to 80% of total global energy production, and account for 71 to 76% of global $CO_2$ emissions. Accordingly, cities have a major role to play in achieving the global climate policy goal of limiting global warming to no more than 2°C.
- Cities are highly vulnerable to climate change, and as such, require coherent, carefully considered mitigation and adaptation strategies, where potential co-benefits between the two, are included.
- With carbon emissions still rising, and the threat posed by climate impacts becoming ever clearer, there is an urgent need for action.
- Existing infrastructure in developing cities is often of sub-standard quality, and thus fails to provide adequate protection from extreme weather events and changing climatic conditions. The urban poor are particularly vulnerable towards extreme weather events.
- Many of the world´s cities are situated along the coast, and as such are exposed to flooding from storm surges and sea level rise. The risk of coastal flooding is further increased in cities affected by subsidence.
- Financing for mitigation and adaptation actions exist, but are difficult to access for cities. Innovative solutions are needed now to close the finance gap.

## Introduction

This paper outlines the role of cities as being drivers of global climate change and at the same time being affected by climate change. In addition to climate change, cities are confronted by challenges in relation to urbanization, natural hazards, and their interaction. The paper highlights the need to reduce greenhouse gas (GHG) emissions through climate mitigation policies, as well as the need for adaptation action to combat existing and potential climate impacts. Moreover, the paper underlines the challenges in finding synergies between adaptation and mitigation measures, suggests possible adaptation responses to inevitable climate change, and points out the financial barriers. The main focus lies on rapidly growing cities in developing countries and emerging economies. Given the complexity and unique characteristics of individual cities, it is not possible to provide an in-depth analysis of existing and projected climate risks, and possible mitigation and adaptation policies, for one particular city. Rather, this Focus-Paper provides a brief overview of various aspects, topics, and sectors of relevance to cities in general.

GERICS Climate Service Center Germany in cooperation with KFW

## Background

Continued population growth and urbanization are projected to add 2.5 billion people to the world's urban population taking urbanized population from a current value of 52% in 2014, to 66% in 2050.[1] Africa and Asia – both still comparatively less urbanized than other regions – are expected to witness the fastest rates of urbanization until 2050 (56% in Africa and 64% in Asia).[2] If managed well, urbanization can bring substantial benefits such as providing growth and rising incomes but also making economic activities more environmentally friendly. Simultaneously, rapid urbanization can alter the magnitude and nature of almost every global risk. In many cities, unplanned or inadequately managed urban growth leads to rapid urban sprawl, pollution, and environmental degradation, further amplified by unsustainable production and consumption patterns. In addition, cities are points of convergence of many risks, which makes them particularly vulnerable to chain reactions and amplify the interconnection between global risks[2] such as natural hazards and climate change impacts.

The concentration of people, assets, critical infrastructure and economic activities in cities exacerbates the potential of natural hazards. Asia, Africa and Latin America have experienced high rates of increase in the incidence of natural disasters over the last three decades, with many urban areas having sustained heavy losses of human lives due to disasters. Total population exposure to cyclones and earthquakes, is projected to rise.[3] Coastal cities of South America have to face more frequent heavy rain fall and higher temperature which could put thousands of homes in the low-income settlements at risk.[4] Major characteristics of such sub-standard housing are the low resilience to natural hazards and climate impacts as well as limited access to basic and emergency services. Rural-urban migration can cause low-income settlements to double in size every 5 to 7 years.[4] Making cities more resilient (i.e. the degree to which a system rebounds, recoups, or recovers from a stimulus), to extreme weather events should be a priority for both local governments.

Climate change and urbanization are closely interconnected with one another. Cities are important economic hubs. As a result, their demand for resources is high. With regard to climate change there is a high potential for mitigation due to high carbon dioxide ($CO_2$) emissions, as well as a high need for adaptation to climate impacts. Possible mitigation options are a progressive transformation towards low-energy, low-carbon, or climate-neutral cities.[5] With respect to the city the GHG emissions savings vary in a broad range (current $CO_2$-footprint in t $CO_2$ emissions per capita and per year: Bogotá: 1.7; Cape Town: 7.5; Caracas: 5.3; Singapore: 8.6),[6] depending on the composition of the local industry and economic sector, transport pathways, and the emission intensity of electricity production. In general, higher residential densities with higher employment densities, coupled with significant public transport improvements and more diverse land use mixes lead to greater emission reductions.[7] The greatest potential for emission reduction in cities lies in sectors such as energy generation and energy efficiency e.g. buildings, transport and waste (Figure 1). More than 75% is related to the burning of fossil fuels used for transportation, heating and cooling of buildings, and manufacturing of goods.[8] Further emission sources indirectly related to cities are emissions such as for energy supply or transport chains.

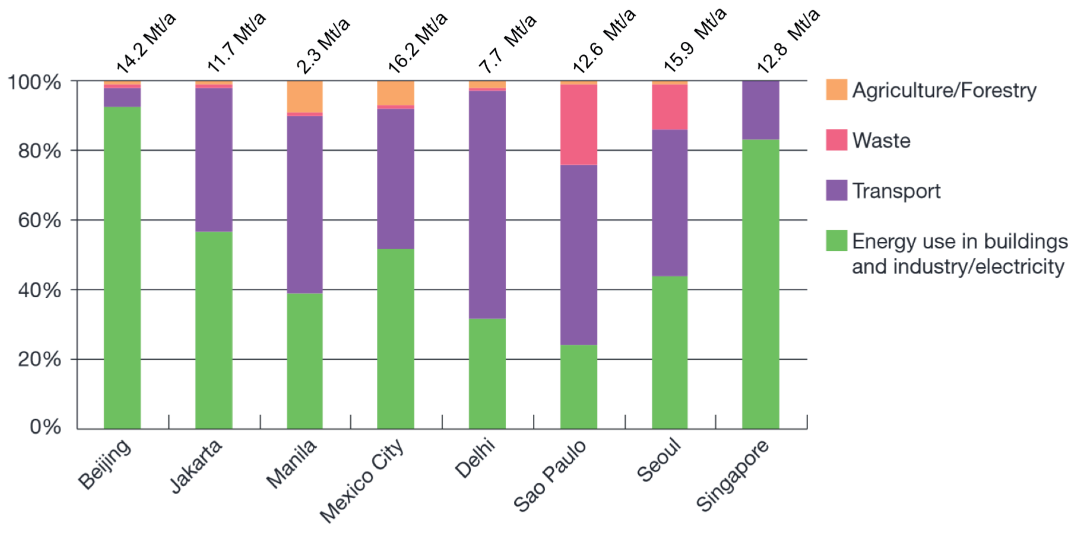


**Figure 1: Carbon emission profiles for metropolitan areas.[9]**

Cities face significant impacts from climate variability and change, both now and in the future, e.g. flooding (urban flooding, flash floods, river flooding), and heat waves leading to elevated levels of several air pollutants[10] provoking health problems. Climate change impacts have major economic implications such as reduced productivity of labour or lost workdays, disruption of transport systems, or efficiency losses in energy generation and transmission. The strategies for adaptation are focused on the regional and local scale, e.g., for questions related to the management of water resources, and the connection of fresh air zones inside and outside the city boundaries. Furthermore, many of the world's cities are already situated in locations prone to multiple natural hazards, or along flood-prone coastlines where the impacts of more extreme climatic events and sea level rise pose a greater risk.[9] The combination of climate impacts, natural hazards, insufficient management strategies and rapid urbanization are likely to put increased strain on the capacity of local governments to cope with these impacts.[11] Because of the serious consequences for human health, livelihoods and assets, two things have to be done: reduction of GHG emissions to reduce future climate impacts and adaptation to existing and anticipated climate impacts and natural hazards.

## Cities' dynamics – accelerating climatic impacts

Increasing urban population leads to a replacement of natural vegetation by artificial surfaces and buildings. This exacerbates urban heat island effects, and reduces the natural retention and infiltration potential for precipitation. Moreover, projected increases in temperature and changes in rainfall will add to this problem.[12, 13] This means that the effects of, for instance, flood disasters or heatwaves are the result of both societal and climatological influences. The implications of climate change for cities are often aggravated by systemic interactions within the city and by events in neighbouring rural areas beyond their own borders.[14]

There is evidence that societal change and economic development are the principle factors responsible for increasing losses from natural disasters.[15] High economic losses caused by floods include direct losses e.g. damage to economic and social infrastructure, public and private property due to the flooding itself, erosion or landslides, and indirect losses in or beyond the flooded areas, for example interrupted power generation, deteriorated groundwater quality caused by pollution or salinization in coastal areas. Socio-economic challenges in the form of lower productivity, failure of services, loss of jobs and income sources or other disruptions in financial markets (e.g. closing of stock exchange) pose additional problems.[16]

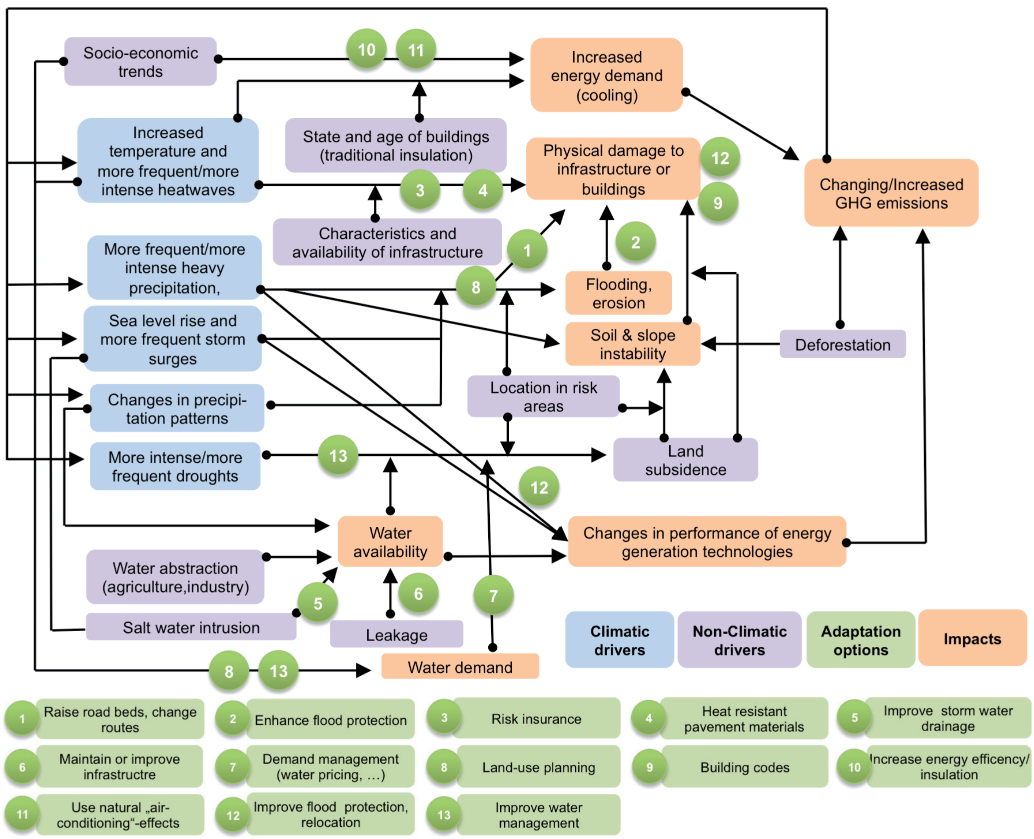


**Figure 2:** System map of drivers in urban areas and selected adaptation entry points to reduce vulnerability (©GERICS).

The system map in Figure 2 is an approach to show the main interactions of climatic and non-climatic drivers, their impacts and some selected adaptation options. Although it is not exhaustive in its scope, it does provide an overview of the complexity of urban areas and the numerous sectors affected by climate and non-climate impacts, and the potential entry points for climate adaptation.

**Major aspects of climate change relevant to cities are:**

→ **Heat waves:** It is likely that heatwave frequency has increased since the middle of the 20th century in large parts of Europe, Asia and Australia.[17] It is also very likely that they will occur with a higher frequency and duration, mainly as a direct consequences of the increase in seasonal mean temperatures.[18] Their effects might be intensified due to concrete and materials of the built environment that reflect less sunlight and thus absorb more heat and moreover retain it longer than vegetation does. To counteract this enhanced warming due to the physical properties of cities, adaptation measures are needed. Options include climate proofed urban structures, such as dense settlements with fresh air corridors as well as the use of green and blue infrastructure (e.g. urban green, open green spaces, rain gardens, permeable pavings, storage ponds, reservoirs, vegetated ephemeral waterways).

→ Monitoring data suggest that a significant current increase in **heavy rainfall** events is already occurring in many urbanized regions.[17, 19] Increasing impervious areas in cities can exacerbate flash flooding because of limited natural water retention and infiltration that cause increased stress on storm water systems.[13] Adaptation options are inter alia water permeable pavements, extra green spaces, or the separation of rainwater and sewage water.

→ It is likely that the frequency and intensity of **droughts** has increased in the Mediterranean and West Africa and decreased in central North America and north-west Australia since 1950.[15] Drought-affected areas are projected to increase in extent, with the potential for adverse impacts on multiple sectors, including food production, water and energy supply, and health.[14] Adaptation options are rainwater harvesting or artificial groundwater recharge.

## Climate change – regional and typological differences

Besides the different available financial resources and capacities to run and maintain basic infrastructure the geographic exposure is another important topic for the planning and implementation of proactive measures into urban governance, planning processes[20] and investments. Figure 3 provides a quick overview of the different risks cities all over the world have to face. They cover natural disasters (earthquakes, volcanic activities, seasonal storms) as well as projected climate impacts (river floods, heatwaves, water stress). The three risk levels refer to national and global information, for this reason variations are possible on a local scale. To better estimate this factor selected cities with currently monitored risks are depicted in the map, too. Figure 3 highlights the need for all cities worldwide to consider mitigation and adaptation measures.

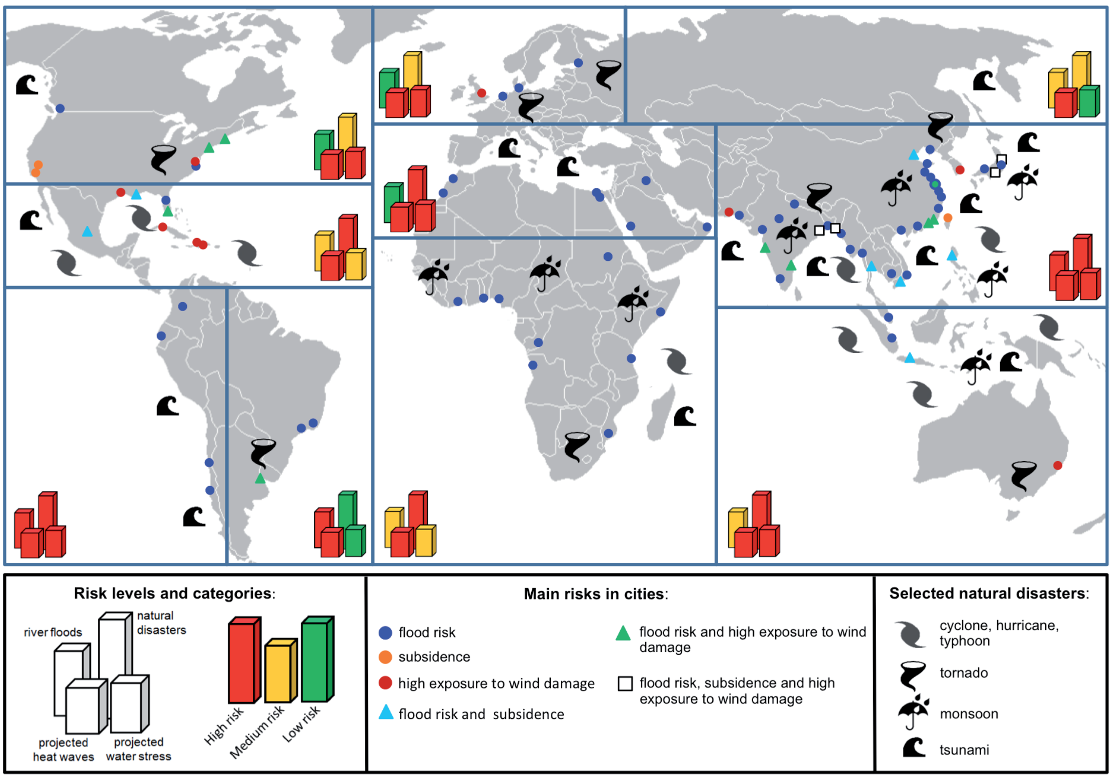


Figure 3: Global overview of the main natural and expected climatic risks for cities (based on the literature used) (©GERICS).

Typical challenges for cities are:

- → **Coastal/delta cities:** Cities in low-elevation coastal zones as well as cities located on coastal river deltas, face the combined threat of several impacts. These are coastal and river flooding, salt-water intrusion affecting drinking water supplies, increased coastal erosion and reductions in liveable land space for people as well as for ecosystems.[11] A "hidden" but urgent threat is land subsidence due to excessive groundwater pumping. The impacts of subsidence are further exacerbated by extreme weather events (short term) and rising sea levels (long-term). Examples are Jakarta, Ho Chi Minh City, and Bangkok. In the future, all these cities are projected to be most at risk in terms of absolute average annual flood losses. Many coastal cities in the developing countries are found in tropical areas with hot and humid climate conditions. Moreover they are vulnerable to natural hazards such as storms, monsoon and tsunamis, too.[4] Nevertheless the projected population growth in these areas will continue undiminished. The 22 cities with the highest exposed population in Asia, Africa and Latin America in 2070 are depicted in Table 1.

**Table 1: Cities at risk of coastal flooding, ranked by exposed population and exposed rates in 2070.[21]**

| Rank | Urban Region | Country | Exposed Population (2008) | Exposed Population (2070) | Rank | Urban Region | Country | Exposed Population (2008) | Exposed Population (2070) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Kolkata | India | 1,929,000 | 14,014,000 | 12 | Khulna | Bangladesh | 441,000 | 3,641,000 |
| 2 | Mumbai | India | 2,787,000 | 11,418,000 | 13 | Ningbo | China | 299,000 | 3,305,000 |
| 3 | Dhaka | Bangladesh | 844,000 | 11,135,000 | 14 | Lagos | Nigeria | 357,000 | 3,229,000 |
| 4 | Guangzhou | China | 2,718,000 | 10,333,000 | 15 | Abidjan | Ivory Coast | 519,000 | 3,110,000 |
| 5 | Ho Chi Minh City | Vietnam | 1,931,000 | 9,216,000 | 16 | Chittagong | Bangladesh | 255,000 | 2,866,000 |
| 6 | Shanghai | China | 2,353,000 | 5,451,000 | 17 | Jakarta | Indonesia | 513,000 | 2,248,000 |
| 7 | Bangkok | Thailand | 907,000 | 5,138,000 | 18 | Surat | India | 418,000 | 2,020,000 |
| 8 | Rangoon | Myanmar | 510,000 | 4,965,000 | 19 | Qingdao | China | 88,000 | 1,815,000 |
| 9 | Hai Phòng | Vietnam | 794,000 | 4,711,000 | 20 | Guayaquil | Ecuador | 412,000 | 1,196,000 |
| 10 | Alexandria | Egypt | 1,330,000 | 4,375,000 | 21 | Xiamen | China | 269,000 | 1.034,000 |
| 11 | Tianjin | China | 956,000 | 3,790,000 | 22 | Lomé | Togo | 119,000 | 858,000 |

- → **Dryland cities:** Generally, these cities suffer from scarce water resources due to extended droughts. In addition to climate change cities have to face local natural hazards covering earthquakes, land subsidence due to groundwater overexploitation, sand storms, flash floods and seasonal inundation. The effects of droughts are widespread but can be particularly severe on drinking water supplies and food prices.[4] According to climate projections water scarcity will increase. Climate change will amplify existing water stress.[22] Examples are: Addis Abeba, Cairo, Mexico City, New Delhi. Water scarcity is expected to be a major challenge in Asia.[23]
- → **High-altitude cities:** Climate change affects high-altitude regions at a faster rate than areas at lower altitudes. The predominant climate change impacts for these cities are melting of glaciers,[24] heavy precipitation and changes in the interannual variability of precipitation amounts and patterns. Local flood events, flash floods combined with mudslides and high fluctuations of groundwater levels affect people's lives and properties. Impacts of the shrinkage and disappearance of mountain glaciers include changes in the flow characteristics of glacier fed rivers, glacier lake outburst floods and water shortages.[24] Main problems occur in areas where the water supply and energy production depends on the melting water of a glacier, examples include: Bogotá, La Paz, and Kathmandu.

## Climate change – impacts on chosen sectors

Cities' stability and prosperity rely on vast networks of infrastructure which provide essential services – solid waste disposal, wastewater treatment, transportation, drinking water, energy and sanitary provisional systems. However, in many low-income cities, urban infrastructure is insufficient for dealing with current urbanization rates and climate variability. One big challenge is to plan for the "unplanned", also considering needs in informal settlements or of informal paratransits without basic infrastructure. Total economic losses from natural disasters are greatest in developed countries, while deaths from natural disasters are highest in developing countries. One reason for the higher death rate is the lack of adequate early warning and monitoring systems.[25]

**Mobility and transportation:** Climate change impacts create several challenges for transport systems. On the other hand the transport sector must be part of mitigation solution, too. The daily functioning of most transport systems is already sensitive to today's weather fluctuations in precipitation, temperature, winds, and - for coastal cities - storm surges and rising sea levels with the associated risks of flooding and damage. The indirect costs of delays, detours, and trip cancellation may also be substantial. The severe floods in Mumbai in 2005, Jakarta in 2007, Rio de Janeiro in 2010, Bangkok in 2011, and Nairobi in 2015 caused injuries, deaths, property damage and serious indirect impacts. Disaster response strategies, industrial production, food supply, or health and other community services might suffer from disrupted transport infrastructures since transport and other urban infrastructure networks are often interdependent and located in close proximity to one another.[12] The design of urban form and an associated transport network will play a significant role. Four major strategies are available to increase resilience: maintain and manage; strengthen and protect; enhance redundancy and relocation.[12] Prioritizing access to pedestrians and integrating non-motorized and public transit services cannot only result in lower emissions but also in higher levels of economic and social prosperity. Good opportunities exist for both structural and technological change around low-carbon transport systems in most countries but particularly in fast growing emerging economies where investments in mass transit and other low-carbon transport infrastructure can help avoid future lock-in to carbon intensive modes.[26] Co-benefits are better access to mobility services for the poor, time saving, energy security, and reduced urban pollution, which leads to better health. It is of high importance to consider planning processes today since transport infrastructures usually have a live time of up to 100 years and more.[27]

**Energy:** Increasing energy demand leads to an increase in GHG emissions from the energy sector. This trend is set to continue, driven by economic growth and rising population. Reducing energy demands, increasing the efficiency of energy production technology, and shifting to renewable and cleaner energy sources can lower GHG emissions. On the other hand energy exerts a major influence on economic development, health, and quality of life. Any climate change related disruption or unreliability in power or fuel supplies can have far-reaching consequences, affecting urban businesses, infrastructure, services (including healthcare and emergency services, schools and public safety especially street lighting), and residents, as well as water treatment and water supply, rail-based public transport, and road traffic management. Critical energy infrastructure is at risk in coastal areas being affected by rising sea levels and those in cold climates being affected by thawing permafrost. Electricity grids as well as energy transmission infrastructure (e.g. pipelines and power lines) would be impacted by extreme weather events (e.g. storms, icing). Higher temperatures may affect electricity generation including thermal and hydroelectric stations in some locations. However, the life time of infrastructure components varies between 5 and more than 50 years. Thus decisions made in the next couple of decades will be crucial in deciding whether the energy sector leads the way towards a reduction of emissions.[27] A currently emerging topic is adaptation of energy infrastructures. Options to increase the resilience include retrofitting thermal power plants with independent cooling systems or relocation of relay stations to protect them from flooding.

**Water supply, wastewater and sanitation:** With respect to the urban water cycle a sustainable, efficient and equitable management of water is the main goal. New strategies need to pay attention to changes in the water cycle due to altered precipitation, runoff and groundwater recharge patterns.[1] Wastewater systems have to focus on extreme high water amounts during heavy rain events as well as on no flow or small quantities during dry periods. An important issue is the maintenance of old systems or the lack of provision for drainage in most unplanned settlements and in many urban centers.[12] Climate change is expected to intensify droughts, resulting in disruptions to water supply even in humid areas. Water-stressed regions with an annual per capita water availability below 1,000m³ are the most at risk; these include water basins in North Africa and the Middle East, the Mediterranean, South Asia, North America, northeast Brazil, and western South America. Projected changes in precipitation imply possible alterations in the frequency and occurrence of fluvial floods, although there is low confidence in projections of these changes.[28] On a regional and local scale, it has to be taken into account that trends in floods are strongly influenced by changes in river management. In the absence of proper sanitation, flooding can, in turn, lead to pollution of water with contaminants from human waste and debris. Due to expected higher water demand in urban areas, there is an increasing risk for further overexploitation of water resources enhancing local subsidence. This increases the exposure for people and assets in low-lying coastal areas in combination with sea-level rise.[29]

## The case of Mexico City

The Mexico Valley is exposed to rising extreme temperatures, which, in conjunction with ongoing urbanization, has contributed to a significant heat island effect for Mexico City. Projections for 2100 show an increase of the mean temperature by 2 to 3°C. Simultaneously, more precipitation is expected, too. This consequently leads to higher risks of flooding and landslides, particularly in the western part of Mexico City.[4] In addition, the urban water management system cannot cope with droughts which result in an overexploitation of water resources. According to the projected population growth, the available water resources will diminish and subsidence will exacerbate. As a result foundations of buildings and urban infrastructure might be damaged and their vulnerability to hazards such as heavy earthquakes and heavy rains might increase.[8]

A connection between urban and population growth, higher water demands and land subsidence can be observed worldwide. Other examples are Jakarta, Ho Chi Minh City or Bangkok (Figure 3 and Table 1).

**Built environment:** Rising temperatures increase the risk that buildings are becoming too hot and uncomfortable. Overheating may affect peoples' health and economic productivity. Consequently, the energy demand for cooling rises. More frequent and prolonged dry spells cause damage to urban green. More intensive rain events may increase the risk of flooding of both residential and non-residential properties. Flooding is often made worse by uncontrolled city development that builds over natural drainage channels and flood plains.[30] Most existing buildings were designed for past climatic conditions. Therefore, there is a major need for suitable approaches for adaptation to future climate conditions exists. Preferable options that combine mitigation and adaptation aspects are passive cooling measures for buildings (e.g. green roofs, insulation, climate-proofed urban planning; see Figure 4). As a further positive aspect these measures help to lower energy demand for heating in winter, too. The overall level of risk faced by this sector may be intensified furthermore by interdependencies with other sectors (Figure 2). Interruptions of energy supplies, increased pressure on water supplies, and increased frequency of urban flooding could have major impacts on the built environment.

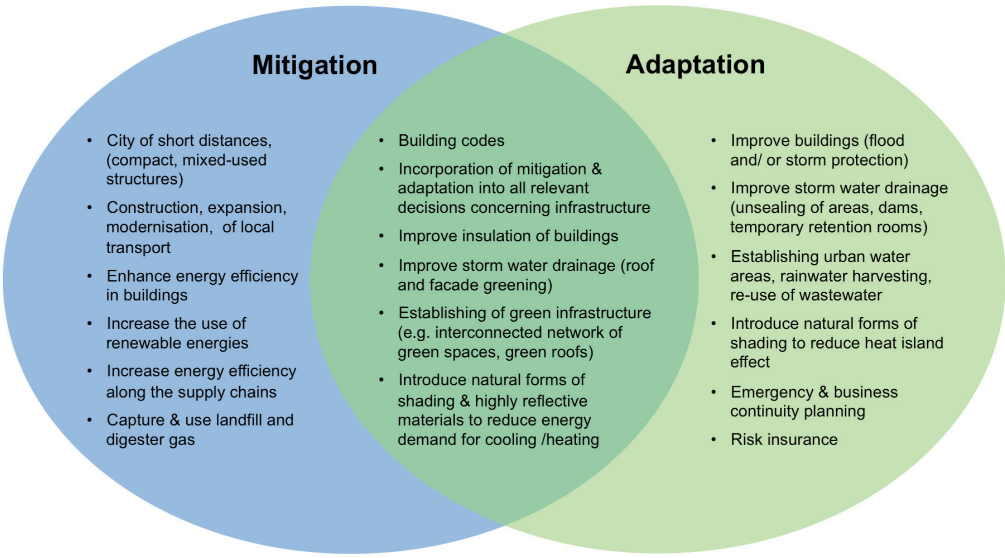


**Figure 4: Selected mitigation, adaptation and synergy measures for climate compatible development (based on the literature used) (©GERICS).**

**Waste management:** Climate benefits of waste practices result from avoided landfill emissions, reduced raw material extraction and manufacturing, carbon bound in soil through compost application, and carbon storage due to recalcitrant materials in landfills.[12] The "waste economy" in cities is a very important topic because it provides livelihoods and contributes to waste reduction and GHG reduction. In Brazil's main cities, more than half a million people are engaged in waste picking and recycling, in Lima an estimated 17,000, and in Cairo 40,000.[12] In particular, there is a general global consensus that the climate benefits of waste avoidances and recycling far outweigh the benefits from any waste treatment technology, even where energy is recovered during the process.[30] Furthermore, the informal waste sector is typically ignored. On the one hand it contributes to resource recovery and GHG savings, and on the other it is one major driver for urban flooding due to blocking drainage channels with solid waste.

## Connecting climate finance to cities – challenges and opportunities

Financing climate change mitigation and adaption on the city scale is a challenging task embedded in a rapidly changing framework. At the same time there is an urgency to act now in order to meet the challenges associated with climate change. Several national, bi- and multi-lateral financing mechanisms have been established, which either predominantly finance mitigation or adaptation projects. However, recent studies revealed that multi-lateral climate funds spent only a small proportion of their volume for projects in cities (Figure 5), of which roughly 90% went into mitigation, in part due to higher costs in these projects.[32] The main reasons for a relative lack of funding projects in cities (and especially adaptation projects), are relatively high transaction costs for participation and, more importantly, most of the existing programs primarily address the national governments and not the city level. Additionally, cities face various obstacles in designing bankable projects for financiers.[32, 33] To close the financing gap on the local level where adaptation and mitigation measures are implemented, new strategic approaches are needed. This includes new funding instruments such as national, regional or local funds that are easier to access, the integration of local financial intermediaries,[33] financial incentives for climate compatible development, new tools and methods to assess costs and benefits of measures to support administrative decision-making[34] (e.g. the use of risk assessments),[35] and the support of soft skills and project design (e.g. technical assistance, capacity building etc.).[32, 33]

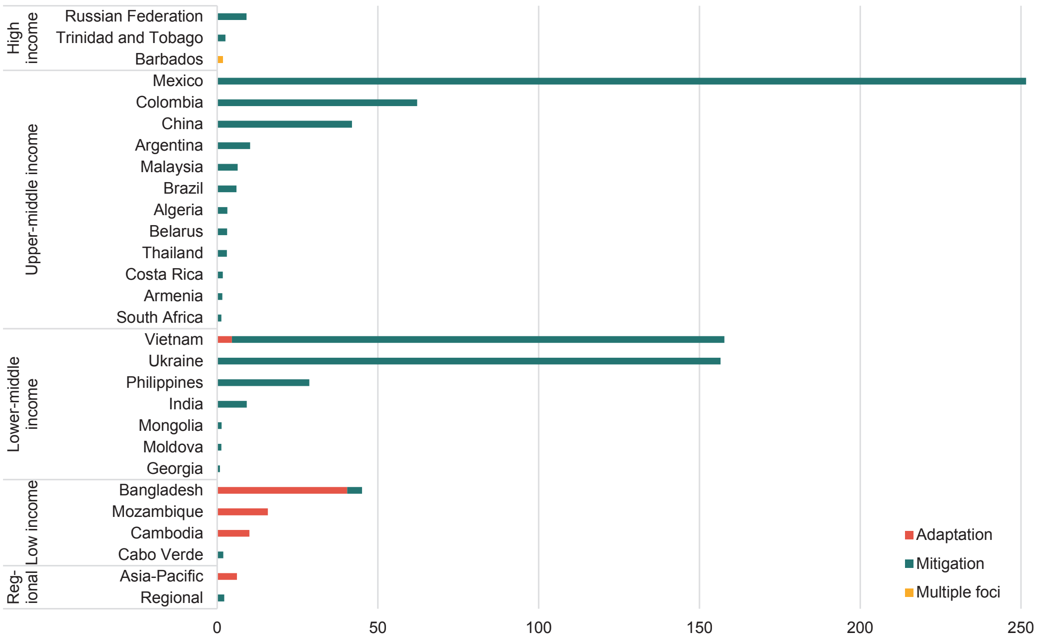


**Figure 5: Finance approved for explicitly urban projects 2010-14, by country and income level (in US$ millions).** [32]

**Health:** Climate change affects the social and environmental determinants of health – clean air, safe drinking water, sufficient food and secure shelter. Extreme high air temperature can lead to death, particularly among elderly people. Associated high concentrations of ozone and other air pollutants can lead to an exacerbation of respiratory diseases. Pollen and other aeroallergen concentration levels are higher under extreme heat. Sea-level rise, floods and extreme weather events can destroy homes, medical facilities and other essential services.[31] More frequent and longer dry periods as well as all types of flooding affect the supply of fresh water and result in a risk increase of water-borne diseases. In extreme cases water scarcity leads to famine. Climate conditions also affect diseases transmitted through insects, snails or other cold blooded animals.[31] They can lengthen the transmission seasons of vector-borne diseases and alter their geographic range. Areas with weak health infrastructure will be the least able to cope with climate change impacts on health without assistance to prepare and respond. Major health co-benefits can be gained by cleaner energy systems, the promotion to use public transportation or for active movement. These actions could reduce GHG emissions and ambient air pollution, too.[31]

## Outlook

Cities have the potential to be transformative leaders. Thus, there is an urgent need to support cities and city administrations to cope with the complex task of climate change mitigation and adaptation, but the window of opportunity is closing quickly.

To enable this potential, however, cities need the necessary financial endowment, which, especially in developing countries, is often not available. Thus, climate financing needs to specifically address the local level, which it currently does only to a limited extent. Financing should not only support 'hard' investments, it should also be available for climate risk analysis, technical assistance, or capacity building.

Many mitigation and adaptation measures are already available and have been implemented successfully in many cities. In order to significantly reduce cities' $CO_2$ emissions and to foster adaptation, cities need support in planning, designing and financing climate compatible development, such as compact settlement structures, energy-efficient buildings or low-carbon transport systems.

Due to the complex interaction of non-climatic and climatic drivers, the implementation of mitigation as well as adaptation measures takes time. Besides financial aspects, many actions could be accelerated by reducing overlapping responsibilities in different agencies, and by building the capacity of human resources.

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## Terms of use Climate-Focus-Paper –

**December 2015**

## Preamble

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The Climate Service Center was founded in 2009 by the German Federal Ministry of Education and Research. Starting in June 2014, the center was institutionalized in the Helmholtz Association. Since July 20th 2015 the center is renamed in Climate Service Center Germany (GERICS).

GERICS offers in a scientifically sound manner products, advisory services and decision-relevant information to support government, administration and business in their efforts to adapt to climate change. One of the main tasks is to investigate the need for advice with regard to the climate change. GERICS aims to be a link between climate-researchers and climate-advisors. GERICS addresses therefore the needs of scientists as well as of practitioners and offers customer-oriented services and products, amongst others (raw) data as well as processed data-sets, e.g. Climate-Focus-Papers.

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