Sinking cities: what economic and governance conditions lead to greater resilience?

Colette Ashley[1], Elisa Elliott Alonso[1], Oriana Romano[2]

KEYWORDS

Urban flooding, urban planning, climate resilience, urban resilience, coastal cities, delta cities, megacities, climate change, sea level rise, land subsidence, flood risk

ABBREVIATIONS

OECD	Organisation for Economic Co-operation and Development
SLR	Sea-level rise
SDG	Sustainable Development Goal

ABSTRACT

Many major coastal and delta cities around the world are in danger of experiencing “too much” water. The effects of climate change exacerbate this threat by increasing the intensity and frequency of water-related disasters. According to OECD estimates, by 2050, 1.6 billion people will be at risk of flooding, affecting nearly 20% of the world’s population at an increasing rate. The consequences of floods are far reaching and flooding events make up one-third of all economic losses due to water-related risks. Moreover, by 2050, 40% of the world’s population will inhabit water-stressed river basins, with consequences including more groundwater extraction to respond to the need of the increasing global population. As such, the risk of cities to “sink,” losing elevation to be at or below sea level, is increasing over time. This paper argues that one single issue of vulnerability does not drive sinking in terms of floods, but that it often concerns a combination of sea level rise, flood risk and land subsidence. This paper seeks to investigate the economic and governance conditions that could help “sinking cities” increase their resilience, through the 3Is framework: investment, innovation, and integration of policies. It also provides a broader overview on water resilience in cities.

Disclaimer: The opinions and arguments expressed herein are those of the authors and do not necessarily reflect the official views of the OECD or its member countries.

1 INTRODUCTION

The 2030 Agenda for Sustainable Development calls for “inclusive, safe, resilient and sustainable” cities (SDG 11). The achievement of this goal greatly depends on the effectiveness of water management, access to water supply and sanitation and increased levels of water security. Therefore, cities can only develop sustainably if they provide reliable water and sanitation services to city dwellers and manage the risks of too much water (floods), too little water (droughts) and too polluted water. However, in both OECD and non-OECD countries, current levels of service delivery and water security

[1] Junior Policy Analyst, Water Governance Programme, Cities, Urban Policies and Sustainable Development, Centre for Entrepreneurship, SMEs, Regions and Cities, OECD

[2] Head of Unit, Water Governance and Circular Economy, Cities, Urban Policies, and Sustainable Development Division, Centre for Entrepreneurship, SMEs, Regions and Cities, OECD

should not be taken for granted, especially in relation to the megatrends that cities are exposed to, including climate change, demographic growth and urbanisation. According to an OECD study of 48 cities, 92% were concerned about ageing and obsolete infrastructure/lack of infrastructure; 90% about national laws and regulations; 81% about extreme events; and 79% about climate change when it came to their water governance systems (OECD, 2016[1]).

Rapid urbanisation, economic growth, increasing populations, and climate change are all stressing water supplies and increasing water-related risks. In coastal and delta cities, changing population patterns—including large population displacement—drive sharp increases in urban water demand, which puts water-scarce cities at risk of running out of water supplies. Population growth increases the likelihood and potential impact of floods, since it puts pressure on sewer systems and encourages urban expansion into areas at high risk of flooding. Densely populated deltas, which globally have a population of more than 500 million, are particularly susceptible to human-induced land subsidence due to their geological setting. Rapid urban expansion can result in the loss of farmlands, forests and lands, thus increasing the pressure on drainage systems. This can lead to increased flood flow in urban areas, which may constitute hazards for the population and infrastructure. Sinking is only one of the problems that cities struggle with in terms of resilience. More than 70% of the consequences of climate change manifest themselves in the water sector (OECD, 2015). These consequences are expected to accelerate the pace of change, with the most severe impacts expected in the second half of the 21st century. Proper use of resources with circularity and ensuring safe and clear water access, especially in terms of the current COVID-19 crisis will become increasingly important issues to work toward resilience as well.

This paper draws extensively on a decade of OECD work on water governance and its recent developments, namely: OECD work on water governance in cities (2016), the OECD Principles on Water Governance (2015) and their implementation strategy (2018) as well as their application to floods (2019), and on the OECD Programme on the Circular Economy in Cities and Regions. First, sinking cities and the risks they face in terms of socio-economic impacts as well as previous costs of floods are discussed in Section 1.1. Next, a major component of the methodology was to take stock of existing experiences on how cities have addressed their sinking problem As seen in Section 2, a literature review and interviews with city officials highlighted what cities currently have in place in terms of plans for resilience and climate change, focusing on the impact on water security, the effects of water-related risks and the links with land use policy. The results of the literature review and interviews, as found in Section 3.1, demonstrate progress in terms of water management and land use policy and analyses aspects of water governance using the guiding framework of the OECD Principles on Water Governance[1] and the 3Is framework: investment, innovation and integration of policies. The paper concludes by providing a broader overview on water resilience in cities and policy recommendations in Section 3.2. This paper is part on an ongoing OECD research on water resilience in cities.

1.1 SINKING CITIES AND CONTRIBUTING FACTORS

There is not one clear-cut definition of a sinking city; however, for the purposes of this paper, “sinking” signifies a city that has begun and continues to lose elevation—making it at or below sea level—over time. Sinking is not one single issue of vulnerability, but often concerns a combination of sea-level rise (SLR), flood risk and land subsidence[2], a factor that further exposes cities to more frequent and more severe water-related disasters. Sinking can happen through the combined effects of climate change in terms of SLR, increasing frequency of extreme precipitation and increasing intensity of hurricanes, all of which drive an increased flood risk (McKinsey Global Institute, 2020[2]) . Due to weather-related disasters—mainly floods or storms—23.5 million people were displaced in 2016. This kind of displacement can thus have overarching socio-economic impacts, especially when focusing on the city-level. Recent studies have also found that capital stock damage due to riverine flooding is expected to double by 2030 from 2020 levels and quadruple by 2050; this damage is equivalent of

damages increasing from USD $35 billion per year to USD $140 billion per year (McKinsey Global Institute, 2020[2]). In terms of sea-level rise, new modelling projects that under a high-end sea-level rise scenario, residual damage costs could be between USD 1.7 trillion and USD 5.5 trillion over the 21st century (OECD, 2019[3]).

Cities concentrate a large share of water-related risks and consequences. Some cities are located in coastal zones or flood-prone areas; others have negative experiences of heavy rains, straining the drainage systems. These cities are sinking cities, as defined above. Cities suffer the consequences of water-related disasters most often. Episodes of floods that occurred in **Copenhagen, Denmark** (2011) and **New York, United States** (2012) generated enormous damages and economic losses, EUR 700 million in the former and USD 19 billion in the latter (OECD, 2016[1]). In 2006, in the Netherlands, subsidence-related costs were estimated to be over EUR 3.5 billion per year; however, most of these costs are not largely recognized as direct damage from land subsidence (Deltares, 2013[4]). Floods are one of the most costly and damaging disasters, which will pose a critical problem to city planners as they increase in frequency and severity. Costal and delta cities are increasingly exposed to the risks of flood. The consequences of floods are far reaching and flooding events make up one-third of all economic losses due to water-related risks. Between 1980 and 2009, water-related disasters resulted in economic losses between USD 50 billion to USD 100 billion per year (OECD, 2019[3]). Additionally, the value of property exposed to flooding is expected to increase to about 9% of the projected GDP; this estimate predicts that the United States, Japan and the Netherlands are the most vulnerable countries. (Hanson et al., 2010[5]). Additionally, coastal populations are projected to grow more than 300% by 2070 ((Miller and Shirzaei, 2019[6]).

As cities will be increasingly exposed to the risks of “too much”, “too little” and “too polluted” water over the coming years, the question of which governance frameworks can foster greater resilience and help adapt to changing circumstances is particularly important for cities to prepare for the future and to maintain their central role in local, national and global contexts. Reducing flood and other water-risks requires changes both within and beyond the city. Cities can take action to minimise the impact on the people and infrastructure when water rises through land planning actions such as flood barriers and considering flood risk when building new housing and infrastructure, including the promotion of green infrastructure. Changes along the river can help manage the speed of the flow and create places where floodwater can be channelled with minimal consequences. Improvements will only happen if water management is adequately governed across multiple scales, authorities, and policy domains (OECD, 2016[1]). Therefore, policy responses need to be tailored to a given city’s needs, while aligning with national goals and priorities.

Appropriate responses to floods and sinking phenomena should include multiple dimensions of water governance, which is highlighted through the application of the 12 OECD Principles on Water Governance. Aspects such as the promotion of financing mechanisms that respond to flood management mitigation can increase the efficiency of flood governance approaches. Additionally, multi-level governance co-ordination is necessary to address flood challenges, manage trade-offs, share information and co-ordinate upstream and downstream water users. Flood management is a shared responsibility as floods are basin-wide phenomena that do not respect administrative borders. In this respect, stakeholder engagement is crucial to developing platforms to shape long-term strategies and plans within an integrated basin approach. As flood risk intensifies, engaging property developers and landowners will become increasingly important. Furthermore, Governments must treat climate change and flood management as complementary policy domains and foster more efficient investment decisions. Regulatory frameworks can mediate potential clashes between flood regulations and land use and greater involvement of spatial planners and risk managers in policy decisions is also required to mitigate flood risk, as argued in this paper (OECD, 2019[7]).

2 METHODS

Cities that are experiencing sinking, due to any of the contributing factors, could benefit from an integral approach between water and land use. This is illustrated through the literature review, reported in Section 3.1. In many cases, land-use management and water management are treated as differentiated policy sectors, with much fragmentation between them. Water resources often mark the settlement patterns, geography and identity of cities, yet their existence is often separate from the design of urban infrastructure. To ensure sustainability, the need for an integrated approach to the use and management of land and water is increasingly recognised among land use and water planners, local water providers, local authorities and other stakeholders (Hodgson, 2004[7]).

To build upon this literature review, interviews of officials were held for the purpose of this paper in separate cities including **San Francisco, California, United States; New Orleans, Louisiana, United States; Hoboken, New Jersey, United States; Portland, Oregon, United States; Amsterdam, The Netherlands; Australia; Brisbane, Queensland, Australia; and Toronto, Ontario, Canada**. The cities for interviewing were identified first geographically—to determine if they were coastal or delta cities—and then, accordingly to their exposure to water security risks. The interviews took place in March and April 2020.

The assessment of challenges and opportunities follows the guiding framework provided by the OECD Principles on Water Governance, 12 must-do actions for governments to design and implement effective, efficient, and inclusive water policies. The Principles intend to contribute to tangible and outcome-oriented public policies, based on three mutually reinforcing and complementary dimensions of water governance—effectiveness, efficiency and trust and engagement. In addition, the so-called 3Is Framework: investment, integration of policies and innovation is applied to cluster experiences in responding to water related disasters and/ or preventing them. This paper represents the basis of an ongoing OECD research on water resilience in cities, examining the “sinking” problems, as well as other related issues, taking into account an integrated and circular approach.

3 RESULTS

3.1 Key lessons and observations

As revealed by both the interviews with cities and the literature review, technical progress has been made to avoid sinking and the consequences of flood risks. However, there are still governance gaps to take into account. This section will cover examples in cities on the state of the art of policy responses and technical solutions and then expand upon the governance gaps that need to be examined. These observations are analyses taking into account the OECD Principles on Water Governance as guidance framework and the 3 Is approach, whereby Investment, Innovations and Integration across policies are key to increase water resilience in cities, including those facing the issue of sinking. Each of the 3 Is will be discussed below to better understand the economic and governance conditions feeding into efficient implementation.

In terms of **investments**, water security projects are often backed by a variety of funding types. It is necessary to promote financing mechanisms that respond to flood management and any sinking phenomenon mitigation. The Sendai Framework also notes the importance of “public and private investments in structural and non-structural measures to increase economic and social resilience to disasters” (UNISDR, 2015[9]). Estimations of the investment needed to reduce water risks, and cost-benefit analyses are typically used as a basis for decision making on floods (OECD, 2013[10]).

Governments should diversify sources of finance and promote payments for ecosystem services, international development cooperation, co-finance schemes and robust insurance systems. Greater ex ante investment in mitigation and prevention can effectively reduce long-term financial needs. At present, 90% of international assistance goes towards emergency response versus 10% on disaster-

risk reduction and preparedness. In Japan, there was a significant effect of preventive measures—if the Levee Reinforcement prevention project had been implemented before the 2000 Tokai storm flood, USD 5 billion would have been saved (OECD, 2019[11]). The German "Floodlabel" (HochwasserPass) developed by insurance companies and the German Flood Competence Centre as a long-term mitigation approach to support and guide home and building owners in minimising flooding damages. In a first step, Floodlabel helps the homeowner to detect the flood danger spots and weak points in and around the home. It then guides the homeowner in equipping the property for the best possible individual flood resilience, through achievable measures that are easy to apply (OECD, 2019[11]).

Oftentimes, it is crucial to seek funding creatively when city budgets are unable to meet the needs. Examples like the **City of Hoboken, United States**, show that collaboration with various stakeholders can lead to a range of funding. Hoboken has received grants from federal agencies like the Federal Emergency Management Agency (FEMA) for the construction of its resiliency parks, as well as hazard mitigation and pre-disaster mitigation funding. The City's Rebuild by Design program also receives partial federal funding by the US Department of Housing and Urban Development (HUD). Hoboken also received partial funding from a public-private partnership for its Resiliency and Readiness Plan. The **City of Portland, United States** has also worked in public-private partnerships, wherein the city established a willing seller program, in which private property owners can sell their flood-prone properties to the city, which purchases the properties at a fair market rate and then remove the structures. These cities point to the possibilities of creative funding and partnerships when there are limitations of city budgets or lack of political will to designate funding to water security projects.

Conventional approaches to flood risks that often consist of technical solutions like building additional grey infrastructure cannot be the sole basis of decision making because they typically overlook stakeholders' involvement in risk assessment and perception. As such, they fail to account for complex interconnections between policy instruments. Many of these approaches only show long-term negative externalities in cost-benefit analyses decades later, which can ignore climate change impacts as well as indirect costs and benefits. More attention needs to be paid to governance and management as well as grey and green infrastructure measures for living with floods and being prepared for them. Public and private insurance systems are insufficient and fail to integrate a long-term vision to minimise future flood impacts. The persistent financial protection gap leaves households and businesses – and ultimately governments – exposed to significant risk of financial losses.

In terms of **innovative** approaches, first there is a difference between grey and green infrastructure. Grey solutions are considered constructed assets, such as flood defences in the form of dikes, dams and embankments, and are typically used in urban areas. Physical flood protection measures, such as dikes and levees, are generally cost effective in areas with high population and asset concentrations. However, technical solutions have mainly been the mitigation for flood risks, including both grey and green infrastructure. The **City of Portland, United States** introduced a five-year initiative in 2008 called Grey to Green to encourage green infrastructure as a means of storm water management. One portion of this initiative was an incentive program for private property owners to build green roofs on their buildings. Since the initiative, Portland has implemented a code requirement for green roofs on 70% of a building if it is above a certain area in size. The **City of Hoboken, United States** has implemented its Green Infrastructure Strategic Plan to bring forth substantial amounts of green infrastructure to curb coastal flooding and storm surge. Part of this plan includes the construction of three resiliency parks, two of which have already been constructed and the third under way. The parks provide additional storm water management apart from the combined sewer system. Hoboken's Green Streets Strategy also includes green infrastructure in terms of green streets and street raingardens. Hoboken looked to green infrastructure to get a more cost effective approach to storm water management, while also providing beautification, air quality improvement, aesthetic value, habitat improvement and noise mitigation. Green infrastructure can be a beneficial tool to cities undergoing any

type of urban regeneration or development and could certainly have an impact in terms of protecting cities from sinking phenomena.

In order to implement non-technical innovative systems, there is a widely acknowledged need for improved water governance across multiple levels of administration, sectors and stakeholders that can manage water for multiple values. Several countries have put in place “pacts” to achieve common goals across levels of governments and build capacities (Charbit and Romano, 2017[12]). For example, in the Netherlands, the Climate Adaptation City Deal was signed in 2016 between the Ministry of Infrastructure and the Environment, three regional water authorities, five cities) and seven other partners (research centres and companies). The aim was to create a learning environment for climate adaptation at urban level for the next four years. In particular, it promoted innovative ideas to tackle flood risks, to foster an integrated approach between water and spatial planning, and to enhance co-operation in general. Innovative practices regarding are only possible when a large range of stakeholders involved. Integration of technical data within public policies is crucial to developing effective policies to avoid any further sinking. A start on innovative planning would be to re-examine the current state of insurance and catastrophe bonds in vulnerable cities. Innovations in terms of financing and building resilience is significant when it comes to planning policies related to subsidence and its associated water-related risks. This is an opportunity to foster innovative partnerships with the private sector.

The **integration of policies** is essential if governments wish to meet the range of sectoral policy to move forward in protecting cities from floods, SLR and land subsidence. Within the context of climate change, most cities create a strategic plan for greater water security and resilience as demonstrated in the interviews with cities. San Francisco Planning in the **City of San Francisco, United States** has organised a series of plans to address resilience in the face of climate change. Its Ocean Beach Master Plan (2015) largely consists of reactive responses to SLR and involves ten different groups of public stakeholders. It includes measures such as adding sand to beaches to control coastal erosion and moving a portion of the Great Highway inland (Sengupta, 2020[13]). The **City of New Orleans (United States)**’ Hazard Mitigation Office created a Hazard Mitigation Plan in 2015, which accounts for risks related to floods, hurricanes, land subsidence, coastal erosion, storm surge and dam and levee failure. New Orleans also releases a Hazard Mitigation Annual Report, which recounts meetings, engagement efforts, hazard identification, estimated property damage, changes in vulnerabilities and capabilities and mitigation actions. However, it is important for other cities to take a more proactive approach, and start implementing these types of plans before a major natural disaster strikes, as some of the plans of New Orleans came about as a reaction to Hurricane Katrina in 2005.

Water management and land use should be increasingly integrated to avoid negative effects. Land use planning is linked to the development of zoning plans or land use plans, which directly affect property rights and landowners. Examples of negative effects concern urban flooding in inadequately maintained built-up areas, which requires measures to manage run-off, which increases with impervious surfaces (roads, buildings) that do not absorb surface water. Run-off generated in areas of urban sprawl is approximately ten times greater than that in more dense urban areas. Specifically, large parking lots and wider roads often cause higher levels of run-off. This calls for more systematic and integrated policy packages between water and urban planning. As such, Amsterdam, the Netherlands, is introducing a multi-layer safety approach in spatial planning that considers prevention, risk reduction and emergency management of water-related risks. The **City of Cologne, Germany** co-ordinates water and spatial planning for new building areas to prevent flood damages because of heavy rainfalls (OECD, 2016[1]). Regulatory instruments such as spatial planning can reduce the exposure of new assets to water-related hazards, as well as reduce the impact of hazards by dedicating land to natural buffers and retention areas, such as wetlands.

There are several theories integrating water management and urban or development planning, such as the Water Sensitive Urban Design, Integrated Urban Water Management (IUWM), and One Water (Bahri, 2012[17]); (Wong and Brown, 2009[14]); (Mukheibir and Currie, 2016[18]). Variations of these concepts also include the Blue-Green City concept that originated in the United Kingdom, as well as the Sponge City concept hailing from the People's Republic of China (Chan et al., 2018[19]); (Li, Qin and Du, 2018[20]). In water management, integrated water management approaches recognise that water acts in accordance with geographical and hydrological factors, rather than administrative boundaries (Ashley et al., 2013[15]). Therefore, stakeholders in water catchment basin areas must work across territorial and administrative boundaries, which can occasionally lead to even further fragmentation. Land-use planning and land governance on the other hand, are some of the main competences of cities and municipalities, in which their powers as an authority stand out. Cities can rarely make water management decisions on their own, but they do have the prerogative to respond to water risks effectively through their urban planning and development processes and tools.

Academic and practical evidence suggests the need to manage urban water management in an integrated approach with urban planning and design. However, these approaches are mostly based on technical considerations, and they emphasise the need for infrastructure, including techniques for rainwater harvesting, green storm water infrastructure, etc. Yet, what is often overlooked are governance aspects as enabling conditions to put the technical solutions in place. In particular: roles and responsibilities for managing water in cities are spread across different levels of government and a broad range of stakeholders such as public authorities, service providers, regulators, and river basin organisations. Even in highly decentralised contexts, national governments have a role to play in setting proper incentives and frameworks for urban water governance. Clarifying who does what and at what level of government can help identify potential mismatches, duplications or grey areas and assist in co-ordinating the actions of multiple players in an effective, efficient and inclusive way. Many cities in OECD countries face difficulties in producing, using and sharing policy-relevant data for decision-making and transparency purposes. In some cases, stringent environmental regulation cannot be enforced at lower level and the water sector does not attract sufficient professionals.

3.2 Policy proposals

A resilient city that overcomes sinking is one that has the ability to absorb, recover and prepare for future water-related economic, environmental, social and institutional shocks or risks. Being more resilient requires cities to recognise the need for better understanding of water-related risks, and of the tools that help prioritise action and investments to become more resilient through land use policy and spatial planning. Such a city can survive and adapt to water-related risks such as droughts, foods, storms and sea level rise, and mitigate their impact on urban water system, while ensuring access to high-quality water resources for all residents and protecting residents from water-related disasters. Resilient cities are those that are also, inclusive, smart and circular as argued below.

Reducing flood and other water-risks requires changes both within and beyond the city. Cities can take action to minimise the impact on the people and infrastructure when water rises through land planning actions such as flood barriers and considering flood risk when building new housing and infrastructure, including the promotion of green infrastructure. Changes along the river can help to manage the speed of the flow and create places to channel floodwater with minimal consequences. Improvements will only happen if water management is adequately governed across multiple scales, authorities, and policy domains. Therefore, policy responses need to be tailored to a given city’s needs, while aligning with national goals and priorities.

Inclusion is important in cities to ensure resilience because it means the city prioritises the engagement of all relevant stakeholders in water-related policies and project processes and activities (OECD, 2015[7]) and considers the impact of water risks on all citizens. It is a key challenge to resiliency

that in cities, the population's access to clean and safe water is not necessarily secure. In many cities around the world, the urban poor still lack access to basic water and sanitation services and are at greater risk of suffering the consequences of natural disasters due to the circumstances of their housing status. In this sense, addressing the water and sanitation needs of people living in urban informal settlements will be essential for achieving the SDGs. People living in informal settlements experience a significantly higher risk of suffering floods, landslides and the effects of other natural disasters, because many informal settlements are situated on floodplains and riverbanks and live in closely built structures, which can disturb natural land drainage patterns and watercourses.

Cities must be smart in considering their approach to resilience, meaning that they should promote water efficiency and improve water management throughout communities, while employing smart water systems designed to gather meaningful and actionable data about the flow, pressure and distribution of a city's water. Land use planning approaches to water-smart cities include the restoration of the natural drainage capacity of cities through nature-based solutions or green infrastructure. This includes elements such as incentivising green roofs or gardens to retain rainwater where it falls to reduce surface run-off. Bioswales and tree pits can also be important components of green infrastructure as they improve the infiltration capacity of the subsurface by reducing impervious paved surfaces by pervious pavements and creating green infiltration zones, allowing rainwater soak into the subsurface to subsequently restore ground water charges. Additionally, rainwater-harvesting systems collect rainwater from roofs and other paved surfaces for on-site use and the implementation of storage or detention basins to temporarily hold water and thus prevent floods.

Cities must also look to work towards resilience by ensuring that land use and water policy and governance work together in a circular way. This means that cities should look to implement innovative practices and long-term visions that make the best use and re-use of available water resources. One of the main land-use water strategies for circularity involves closing the urban water cycle. This can come through actions that aim to reduce water use amongst citizens and businesses by raising awareness, improving water efficiency of buildings, storing larger amounts of rainwater from rooftops and paved surfaces and re-using storm water and grey wastewater in buildings or for irrigation. Closing the water loop should be the ideal, along with water-demand reduction policies combining education, information and financial incentives, and with urban planning and land use control in order to protect water resources and expand storage capacities.

4 CONCLUSIONS

This paper found that cities have made substantial progress in terms of a cross-sectoral approach to flood risks posed by sinking. Reponses consisted mainly in ad hoc investments in green infrastructure and climate change planning. Nevertheless, governance gaps remain. These gaps can be addressed through the 3 Is framework: investment, innovation and integration of policies (Section 3.1). This framework helps to identify main practises and challenges in balancing the water management and governance of sinking cities with land use. In particular, it is important to focus on strengthening links between water management and land use.

The connections between urban water management and urban planning lead to environmental enhancement of the city, in what can be considered an "urban water regeneration path". Decisions regarding the use and allocation of one resource directly or indirectly affect the use and allocation of the other (Hodgson, 2004[7]). Facilitating the integration between these two aspects not only helps cities tackle water risks, such as sinking, and ensure quality universal access, but also aids cities to become greener, more aesthetic places, thus improving human health, wellbeing and quality of life. These urban water regeneration concept has been examined from the point of view of flood risk control, the design of sustainable systems of purification that guarantee correct water supply and quality, the rational consumption of water by city dwellers and the planning and management of river areas in cities (Tort-

Donada et al., 2020[8]). In sum, the urban water regeneration concept refers to the recuperation and maintenance of the inherent link between urban environments and the water resources around them.

The literature review above showed that cities that have water management integrated into their climate change and resilience plans have started to recognise the importance of the crossover between land use and water governance. Additionally, ensuring policy coherence across various policy sectors is important, but remains a key governance challenge. Within co-ordination also lies the importance of clearly defining roles and responsibilities of official entities. As illustrated through interviews with city representatives, this can becomes more of a challenge the more the number of parties involved in terms of resiliency planning. The larger the number of groups involved in planning, the less clear these roles and responsibilities tend to become.

Effective resiliency policies to address sinking and proper integration of water and land use policies goes beyond infrastructure solutions; it is key to identify the economics and governance conditions that could help "sinking cities" increase their resilience. This also considers that resilient cities are those that are also, inclusive, smart and circular. These certain aspects highlight the importance of engaging with all stakeholders, including the urban poor and populations living in informal settlements, as these groups are often the highest at risk of experiencing floods, landslides and other water-related disaster risks. Cities should work towards resilience by promoting water efficiency in using smart water systems to collect data within city water use and its surrounding coastal or riverine waters. Additionally, resilience must include a circular approach, in which cities work on innovative practices and a long-term, cohesive vision to efficiently use and re-use available water resources. Further work on these practices and challenges will be needed to increase resilience in sinking cities that could be relevant to tackle other water related risks.

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[1] The Principles intend to contribute to tangible and outcome-oriented public policies, based on three mutually reinforcing and complementary dimensions of water governance—effectiveness, efficiency and trust and engagement. The OECD Water Governance Principles provide the 12 must-do for governments to design and implement effective, efficient, and inclusive water policies. To date, they have been endorsed by 170+ stakeholder groups or government.

[2] A geological phenomenon in which the earth's surface gradually settles, sinks, or lowers as a result of natural and anthropogenic occurrences.