

Principles on Investment and Financing for Water-related Disaster Risk Reduction



June 2019

High-level Experts and Leaders Panel on Water and Disasters (HELP)

Foreword

Water is life. Water is also a threat to life. In the past 20 years, disasters directly affected 4.2 billion people, out of which 4.1 billion, or 98% were by water-related disasters. Economic damage is also enormous amounting to 1.8 trillion US dollars globally in the same period¹.



To cope with this challenge, the High-level Experts and Leaders Panel on Water and Disasters (HELP), the network to mobilize political will for combating water-related disasters, has developed the “Principles on Investment and Financing for Water-related Disaster Risk Reduction” acknowledged by the High-Level Panel on Water². The Principles are in coherence with the Sendai Framework, the Paris Agreement, the New Urban Agenda, as well as the Addis Ababa Action Agenda and contributing to the respective SDGs.

From 2017 to 2019, extensive consultations on earlier drafts of the Principles have taken place in HELP and regional meetings worldwide, inviting over 200 experts from 50 countries. The Principles are supported with a Background Document which provides further rationales, the linkages to the global frameworks, and literature-based factual evidence underpinning the economic cases of financing approaches.

“Water-related disasters” comprise both rapid and slow onset disasters and refer to natural hazards and hydro-meteorological extreme events, such as floods, tsunamis, landslides, debris flows, and droughts. The Principles focus on water-related disasters, because such disasters: i) are directly connected to climate change; ii) occur in most countries, resulting in almost 90% of world top 1,000 disasters³; iii) are strongly linked to poverty issues as water-disaster-prone areas are often inhabited by the poor, who are particularly vulnerable against extreme events; and iv) can be drastically mitigated by effectively using a time lag between the inception of disaster event and the arrival of its impact, allowing people to prepare and evacuate, e.g. heavy rain flood or tsunami⁴.

Pro-poor measures against extreme water-related events should be taken. The public nature and the political drive often choose visible short term results, thus deviates from investing in prevention to avoid future losses on the long term. We should consider building resilience as a huge business opportunity, and the chance to incorporate better coastal and urban design and restore degraded lands.

The toll of water-related disasters in lives and livelihoods has been immense. Unless action is taken soon, the combined effects of extreme water phenomena, climate change, growing populations and urbanization will negatively affect society and economy in many regions, spur migrations, and spark conflicts. When adopted globally and used widely, the Principles will provide central and local governments as well as financial institutions with a practical guidance to apply their investment resources to more effective disaster risk reduction.

A handwritten signature in black ink, reading 'Han Seung-soo' in a cursive style.

Han Seung-soo, Chair of HELP

1 The human cost of weather-related disasters 1995-2015 (UNISDR, 2015)

2 Making Every Drop Count – An Agenda for Water Action (HLPW, 2018)

3 Water and Disaster Risk (UN, 2014)

4 See also The UNSGAB Journey Report (UNSGAB, 2015)

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by

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Double the investments and financing for water-related disaster risk reduction globally by 2025 with a focus on disaster risk reduction/preparedness, and Shift the proportion of financing in international assistance for disaster risk reduction/preparedness and that for emergency response/rehabilitation from the current 10%:90% to a more balanced approach towards eventually 90%:10%.

- Worldwide direct economic losses caused by disasters are significantly increasing, and the number of people affected by disasters is on the rise. The economic damages of water-related disasters alone over the past 20 years amount to about 1.8 trillion US dollars¹. Water-related disasters account for almost 90% of the world's top 1,000 disasters².
- The importance of increasing investments and financing for disaster risk reduction is now widely recognized in international agreements, such as the Sendai Framework for Disaster Risk Reduction. However, about 90% of the international assistance is directed for emergency response and reconstruction/rehabilitation, while the amount disbursed for disaster prevention and preparedness is limited to only 10%³.

I. Water-related disaster risk reduction is indispensable for equitable, resilient and sustainable development

1. Measures implemented in advance to mitigate water-related disasters should not be viewed as a cost, but as an investment in future development. In addition, there are considerable costs of inaction. Disasters interrupt and slow down the economic growth of countries by damaging public and private infrastructure and affecting people and economic activities, which is felt most by the poor.
2. Disasters caused by extreme water-related events can be prevented or mitigated by developing disaster prevention structural and non-structural measures ahead of disaster events. Structural measures include combinations of grey infrastructure with green (nature-based) solutions (e.g. use of wetlands and farming fields for flood retention). Soft or so-called non-structural measures include for example risk-informed urban development and land use planning, multi-hazard forecasting and early warning systems, awareness-raising, drills, and education.
3. The exact balance of investment in structural versus non-structural measures, and grey versus green infrastructure, is to be decided through the development of disaster risk reduction strategies at regional, national and local levels.
4. Water-related disaster risk reduction is a key component of Integrated Water Resources Management (IWRM) and National Adaptation Plan process and should be promoted through participation of water users, to yield multi-faceted benefits, such as efficient water use and enhanced biodiversity. Unevenly distributed water, both temporally and spatially, can be effectively managed by an integrated systems approach.
5. The full value of disaster risk reduction should be recognized with the long-term and wide societal view of its benefits. Among others, the cost of water-related disasters is large and will continue to increase driven by urban development and the impact of climate change.

¹ The human cost of weather-related disasters 1995-2015 (UNISDR, 2015)

² Water and Disaster Risk (UN, 2014)

³ Financing Disaster Risk Reduction (ODI & GFDRR, 2013)

II. Ex-ante measures for water-related disaster risk reduction should be prioritized and incentivized in all sectors

6. Relatively frequent water-related disasters should be forestalled mainly by implementing preventive structural measures at lower cost than the amount spent for recovery. Empirically, one dollar invested in flood and drought resilience measures saves multiple dollars in future avoided losses.
7. Combinations of structural and non-structural measures against large-scale and less frequent water-related disasters should also be implemented, relying more on non-structural measures against larger events in order to avoid devastating damages to the society and economy, while putting the highest priority on protecting human lives.
8. A risk-based planning approach that considers deep uncertainty helps develop a balanced portfolio of structural and non-structural measures which reduce disaster risk in an efficient, adaptive and sustainable manner. The risks and resilience benefits should be quantified and communicated to all stakeholders.
9. A “Build Back Better”⁴ approach should be incorporated into the recovery and reconstruction process so as to improve the resilience of communities and prevent recurrent damages from similar disasters. If well managed, reconstruction processes could be an opportunity for societies to increase their resilience and make economic progress.
10. Disaster risk reduction should be mainstreamed by all economic sectors, such as infrastructure and urban development, industries, and financial business.
11. Investment needs to be enhanced for adaptation measures to climate change, which is projected to increase the frequency of natural water hazards and the scale of loss and damage.
12. Sufficient budget for the maintenance and proper operation, including monitoring and upgrading, of existing and new infrastructure should be secured to prevent malfunction of facilities and the devastating damages caused by deteriorated infrastructure. Budget for meteorological, hydrological and climate observation should be secured as scientific base of all planning and political decisions.
13. Alignment of policies and incentives to encourage disaster risk reduction contributes to minimizing investment needs and avoiding future liabilities.

III. Governments should improve their systems and allocate sufficient budget for water-related disaster risk reduction

14. Governments must prepare legal, fiscal, budgetary, information, and administrative systems for water-related disaster risk reduction. This should include mechanisms for inter-ministerial and inter-agency coordination and collaboration and for accountabilities and hierarchies. The central government should prepare emergency support and financial assistance systems for disaster-affected local governments in case a large-scale disaster exceeds local capacity.
15. It is crucial to define the roles and responsibilities, and to empower and enhance the coping capacity, of all stakeholders, including residents, communities, local governments and the central government.
16. Budget for ex-ante disaster risk reduction should be secured at local level as well as at national level, considering the circumstances and frequency of natural disasters. That budget data should be recorded and made traceable.
17. An emergency reserve fund for disaster response should be secured and swiftly disbursed after disaster events.
18. Governments and financial institutions should ensure transparency, accountability, integrity and effective public participation including the most vulnerable groups in the process of investment planning for disaster risk reduction.

⁴ “Build Back Better” is a concept of recovery and reconstruction to increase the resilience of nations and communities through integrating disaster risk reduction measures into the restoration of physical infrastructure and societal systems.

IV. More funding sources than public disaster risk reduction funds should be mobilized for water-related disaster risk reduction

19. Comprehensive and adequately enforced legislation needs to guide and incentivize the participation and investment of the private sector.
20. Mobilization of private funds⁵ can support increasing demand for resilient infrastructure. Implementation of measures against water-related disasters in conjunction with the other sectors, such as water resources management and urban planning, helps diversify funding sources.
21. Evaluation of actual cost and benefit of water use, including water-related disaster risk reduction, and the multiple values of water - economical, environmental and social - is necessary to rethink a healthy and sustainable development of water-related infrastructure.
22. Capital and operative expenses required for proper disaster risk reduction should be considered in the estimation of lifecycle costs of infrastructure development projects from a design stage.
23. It should be noted that water-related insurance (floods and droughts) is effective to speed up recovery but does not physically reduce the disaster risks. Insurance can improve risk management through payment of risk-based premiums.
24. Systematic reporting and disclosure of water-related risks should be improved through, inter alia, implementation of effective climate-related financial disclosure by companies⁶.
25. Collaboration among the climate, disaster and water communities should be encouraged considering the utilization of respective funds for the purpose of disaster risk reduction.

V. The international community should expand financing for water-related disaster risk reduction

26. International cooperation in disaster prevention should be strengthened under the international frameworks, because disaster damages in a single country may have ripple effects to the world, for example, through supply chain disruptions. Therefore, the international community should focus more on investments for disaster risk reduction, over recovery and reconstruction.
27. Any surplus funds in the pledged assistance of emergency response should be effectively utilized for further disaster risk reduction to build more resilient societies.
28. The international community should encourage the Green Climate Fund (GCF) of UNFCCC and other public and private climate-change-related funds to be more responsive to water-related disasters.

VI. Funding for science, technology and knowledge systems should be strengthened to support sound investment decisions

29. Data and knowledge on the losses, impacts and risks of water-related disasters should be improved to evaluate the effectiveness of investment and facilitate better investment decisions.
30. Cooperation and alliances among science communities should be enhanced to develop and apply science and technology to disaster risk reduction.
31. Investment in education and capacity building should be secured for creating the enabling environment for locally tailored disaster risk reduction policies.

⁵ Priority areas to facilitate private action in disaster risk reduction are data and information, institutional arrangements, policies, economic incentives and communication, knowledge and technology (IFC, 2013).

⁶ Recommendations of the Task Force on Climate-related Financial Disclosures (TCFD, 2017)



Background Note
for
Principles on Investment and Financing for
Water-related Disaster Risk Reduction

June 2019

High-level Experts and Leaders Panel on Water and Disasters (HELP)
and
Organisation for Economic Co-operation and Development (OECD)

This **background document**¹ provides a summary of evidence related to the economic case for investment in water-related disaster risk reduction measures and financing approaches. It aims to provide background to support discussions of the Principles on Investment and Financing for Water-related Disaster Risk Reduction by the High-level Experts and Leaders Panel on Water and Disasters (HELP).

1. Background and context

The year 2020 offers major opportunities to promote alignment and integration between disaster risk reduction, sustainable development and climate change adaptation strategies, and their related financing frameworks. Under the Sendai Framework for Disaster Risk Reduction, Target E calls for the substantial increase in the number of countries with national and local disaster risk reduction strategies by 2020. These national and local strategies are a requisite for a risk-informed approach to sustainable development. It is thereby critical that related financing strategies consider both financing for reducing existing disaster risk and avoiding the creation of new disaster risk. This is supported by target 11.B of SDG 11² and paragraph 34 of the Addis Ababa Action Agenda, which aim to increase the number of cities and human settlements adopting and implementing integrated policies and plans on mitigation and adaptation to climate change and resilience to disasters. Finally, the Paris Agreement calls to enhance action on climate change adaptation before 2020, including significantly increasing adaptation finance. Aligned with this, resilience and adaptation are key focus areas of the UN Climate Summit hosted by the UN Secretary-General in September 2019.

Box 1. Why a focus on water-related disasters?

Specific characteristics of water-related disaster mean they require specific attention:

- Water-related disasters often have wide systemic impacts that require a systemic response, distinct from other types of disasters. For example, local extreme rainfall may disrupt societies hundreds of kilometers downstream.
- Water-related disasters may be felt through many economic sectors because of both direct impacts as well as cascading, indirect impacts due to water's strong interconnectedness via supply and value chains as well as infrastructure networks in the domains of water supply, agriculture, energy, transport, and tourism.
- The political economy of managing the impact of water-related disasters and

¹ This background note was prepared by the OECD Secretariat, with inputs from the members of HELP. This note does not represent the official views of the OECD or of its member countries. The opinions expressed and arguments employed are those of the authors.

² By 2020, 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 for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels.

finding solutions is likely to be highly affected by income and wealth inequality. This may translate into disproportionate impacts on the poor and vulnerable, while at the same time excluding more vulnerable groups from access to public support and assistance.

- The public nature of most interventions to manage water-related disasters can make such measures subject to political short-termism. At the same time, improving the enabling environment for investments in resilience to water-related extreme events is an opportunity to deliver multiple benefits for the economy, the environment and society.

In coherence with the agreements listed above and as a follow-up to the Outcome Document³ of the High-Level Panel on Water, the HELP Principles aim to provide a roadmap for financing water-related disaster risk reduction.

2. The economic case for investing in water-related disaster risk reduction

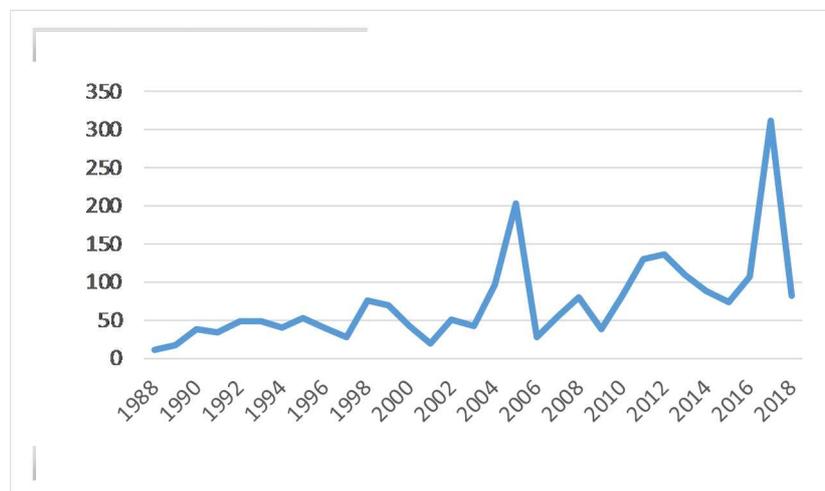
The economic and social costs associated with water-related disasters are high and increasing. As illustrated by Figure 1, 2017 was the costliest year on record for water-related disasters, with major storms and floods in the US Gulf Coast, the Caribbean, Bangladesh, India, Nepal, and Pakistan, among others (Aon Benfield, 2017^[1]). The 2017 hurricane season saw three of the strongest and costliest hurricanes ever recorded in the northern Atlantic, leaving damages of more than USD 245 billion in their wake (Zimmerli et al., 2018^[2]; UNISDR and EM-DAT, 2018^[3]). Water-related disasters make up a high proportion of natural disaster-related losses – in 2017, 92% of such damages⁴ recorded on EM-DAT⁵ were water-related, of which a large portion remains uninsured and affected people financially unprepared.

³ UN HLPW, 2018. Making Every Drop Count – An Agenda for Water Action. High Level Panel on Water Outcome Document, New York.

⁴ “Damage” here is referred to the replacement value of physical assets fully or in part destroyed by a hazardous event. Generally not included in EM-DAT figures are “losses”, i.e. the monetary consequence in the flows of the economy that were inflicted by the temporary absence of the damaged assets.

⁵ Disasters in the EM-DAT database include events where: ten or more people were killed; 100 or more people were affected, injured or made homeless; significant damage was incurred; a declaration of a state of emergency and/or an appeal for international assistance was made. Economic losses are defined as the direct (e.g. damage to infrastructure, crops, housing) and indirect (e.g. loss of revenues, unemployment, market destabilisation) consequences of a disaster on the local economy.

Figure 1. Global total damages from water-related disasters, 1988 – 2018 (in USD billions)



Note: In EM-DAT, water-related disasters comprise floods, landslides, storms (including hurricanes) and droughts. Figures are shown true to the year of the event.

Source: EM-DAT: The OFDA/CRED International Disaster Database, - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium.

Increasing damages and losses are in large part due to the growing concentration of people and economic assets in water-related hazard areas. For example, in the United States, the population in counties along the Atlantic, Pacific, and Gulf Coasts has increased from approximately 47 million in 1960 to 87 million people in 2008, and the number of housing units along the coast has more than doubled from 16.1 million to 36.3 million over the same time period (OECD, 2016^[4]). Globally, trends of increased urbanization in flood zones are projected to continue, especially in Africa and Asia (Winsemius et al., 2015^[5]).

The degradation of ecosystems is also increasing the vulnerability of populations and physical assets to water-related disasters. Wetlands, mangroves and reefs as well as forests perform vital ecosystem services to reduce water-related risk (Spalding et al., 2014^[6]). For example, in Cuba, Indonesia, Malaysia, Mexico and the Philippines alone, it is estimated that the protection from healthy coral reefs exceed USD 400 million in avoided damages (Beck et al., 2018^[7]). At the same time, there are heavy pressures on these ecosystems. 50% of salt marshes, 35% of mangroves, and 30% of coral reefs have been either lost or are degraded worldwide (Barbier et al., 2011^[8]). Increased urbanisation can also cover natural drainage with non-permeable surfaces, such as cement, which can create new water-related risks (Jongman, 2018^[9]).

Climate change is projected to exacerbate the frequency and intensity of water-related disasters and droughts (IPCC, 2018^[11]). In Europe, for example, climate models consistently show a substantial increase in flood risk across most Western and Central countries, which could increase the annual affected population from 200 000 to 360 000 (Rojas, Feyen and Watkiss, 2013^[10]). The expected damage could range, depending on growth and adaptation scenarios, from double the current damage to a multiple by the end of the century (Alfieri et al., 2018^[11]). In addition to the occurrence of hazards themselves, climate change can also increase vulnerability. For example, the *IPCC Special Report on Global Warming of 1.5C* found that between 70% and 90% of coral reefs would be lost if

the temperature increased to 1.5C, and more than 99% if temperature increased by 2C (2018_[12]). This loss would significantly increase flood risk.

The full costs of water-related disasters

Recorded figures on disaster damages underestimate the actual costs of disasters. The assessments of disaster damages shown in **Figure 1** reflect the replacement value of those physical assets that were recorded as damaged or destroyed. Full cost estimates would include losses (or economic costs) as well as other social and environmental damages that are not usually accounted for in monetary terms, such as fatalities, costs of temporary or permanent displacement of people, or the social and psychological impacts of an event (OECD, 2018_[13]). As highlighted in Hallegatte et al (2016_[14]), focusing solely on asset losses can mask the impact of disasters on human welfare and the distributional impacts, which depend on i) how losses affect income and consumption during the recovery and reconstruction phase (relating to how long reconstruction takes and ability of savings to smooth impacts on consumption) and; ii) who is affected (the same loss will have a much stronger effect on the poor and marginalized).

The impact of water-related disasters varies substantially with the level of income of the affected country. Damages and losses tend to be higher in absolute terms in high-income countries, where a large share of global economic assets and productivity are concentrated. The relative share of damages in proportion to national GDP is however higher in developing economies (UNISDR and EM-DAT, 2018_[3]). Looking at drought, there is an especially high impact on human welfare and food security in countries that depend on agriculture. Droughts can lead to famine and migration, the loss of natural resources, and undermine economic performance, with adverse impacts on rural communities and price rises in basic commodities that also affect the urban poor (UNISDR 2018_[5]). In general, poor and marginalized people and communities feel losses more strongly as their livelihoods depend on fewer assets, their consumption is closer to subsistence levels, they cannot rely on savings to smooth the impacts, their health is at greater risk, and they may need more time to recover and rebuild (Hallegatte et al., 2016_[14]).

The benefits of risk reduction

Structural and non-structural disaster risk reduction measures are indispensable to reduce the level of existing risks and avoid the creation of new water-related disaster risks in the future. A number of analyses have aimed at evaluating the economic benefit of disaster risk reduction measures in terms of avoided damages and losses. While the positive returns on investment are highly context and hazard specific, the sample of studies in Table 1 provides an overview of some of the available estimates to date.

Table 1. Overview of studies examining the economic benefits of disaster risk reduction measures

Key finding	Hazard(s) examined	Source & Context
For every \$1 invested in disaster risk reduction, there is an estimated return of \$11 in avoided costs	Hurricane surge, earthquake, hurricane wind, riverine flooding	National Institute of Building Sciences (NIMS) (2018 ^[15]) – Assessment of the benefits of designing buildings to meet 2018 building code specifications, as well as analysis of 23 years of federally funded mitigation grants, United States
On average, for every \$1 invested in disaster risk reduction can render benefits of \$4 for avoided and reduced losses	Flood, wind, earthquake	Mechler (2016 ^[16]) - Review of 52 cost-benefit analysis studies on disaster risk reduction interventions, Global
For every \$1 invested, DRR investments largely pay off, with an average of \$5 saved through avoided and reduced losses	Flood	Mechler, et al, (2014 ^[17]) – Review of 27 CBA studies of flood DRR, Global
On average, for every \$1 invested in disaster risk reduction can render benefits of \$4 for avoided and reduced losses	Flood	MMC (2005 ^[18]) - Reviews 4000 risk reduction grant programs, covering a range of interventions, United States
Capital investment in risk-reduction measures can achieve a whole life cost-benefit ratio of 1:9 or higher	Flood and coastal erosion	Environment Agency (2014 ^[19]) – Assessment of national flood and coastal erosion risk measures, United Kingdom

In addition to avoiding future damages and losses, some types of risk reduction measures can generate additional social and environmental benefits (Vorhies and Wilkinson, 2016^[20]). For example, re-forestation to protect human and physical assets from landslides can also serve a recreational purpose, provide habitat for wildlife and act as a sink for carbon emissions. Construction and use of drainage pipes to reduce flood risk can improve irrigation practices. Training farmers to diversify the use of crops and build resilience to drought can reduce vulnerability to poverty and food insecurity. Risk reduction measures can also serve to increase overall societal resilience, for example by strengthening health and well-being. However, a key challenge remains in incorporating environmental and socioeconomic co-benefits into traditional economic assessments.

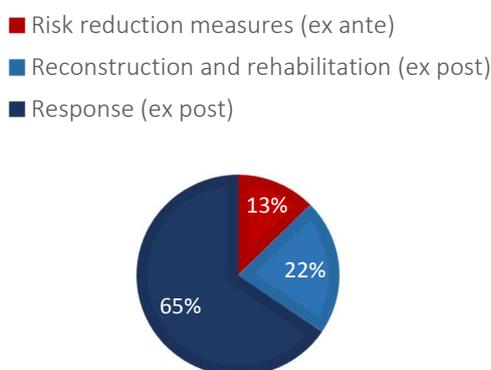
The ex-post bias

Despite these potential benefits, there is evidence of general under-investment in *ex ante* risk reduction and a serious bias towards reliance on *ex-post* response. Although the recording of expenditures for *ex-ante* risk reduction spending versus *ex-post* expenditures is incomplete, (OECD, 2018^[13]), existing evidence points to a tendency of countries towards allocating significantly more funds to disaster response than disaster risk reduction. For example, in Australia, a study by the Council of Australian Governments and the Productivity Commission based on government expenditure data showed that central government spending on *ex-ante* disaster risk management (i.e. preparedness and risk prevention) amounted to AUS\$ 550 million between 2002 and 2014, compared to AUS\$13 billion in disaster relief and recovery spending (OECD, 2018^[13]).

Reasons for the *ex-post* bias in spending include lack of incentives (investments to build resilience often do not produce visibility or immediate gains or benefits); moral hazard (expectations of government compensation *ex-post* impedes upfront investments by subnational governments, households and businesses); low levels of risk awareness coupled with lack of willingness to pay upfront; principal agent problems (local level decision making on land use, lack of incentive to integrate risk); enforcement issues regarding risk-informed land use planning or risk-informed building code application; a lack of incentives to co-operate across jurisdictional boundaries; and high political visibility for *ex-post* assistance (OECD, 2014^[21]).

Trends in development assistance show that *ex ante* disaster risk management represents a very small proportion of overall international development assistance (Kellet and Caravani, 2013^[22]; OECD, 2018^[23])(**Figure 2**). For example, an Overseas Development Institute (ODI) study examining aid spending between 1990 and 2010 on disasters found that of the USD 106.7 billion spent on disasters, \$13.5 billion, was for *ex ante* risk reduction measures, compared with USD \$93.2 billion spent *ex-post* (2013^[22]). In a development context, additional challenges around the *ex-post* bias include the risk of moral hazard, in terms of international assistance that can be expected by national governments in case of a disaster.

Figure 2. Global development finance for disasters (1991-2010).



Source: (Kellet and Caravani, 2013^[22])

3. Enabling investment in water-related disaster risk reduction

To further enable investments in water-related disaster risk reduction, governments must address the market and policy failures that lead to a reliance on disaster response and recovery, despite the strong economic case for investments in prevention. Reversing the rising trend of water-related damages and losses will require aligning policies to improve incentives to reduce exposure and vulnerability to risks, increasing investments in disaster risk reduction, and making better use of existing resources.

How much to invest in managing water-related risks?

Determining the amount of resources to be allocated towards managing water-related disaster risks depends on what level of residual risk is considered acceptable. A risk is considered acceptable if the likelihood of exceeding a given risk threshold (e.g. amount of damages, lives lost) is low (OECD, 2013^[24]). It is neither technically nor financially feasible to aim for a “zero risk” level, as there are usually competing demands and more productive allocation choices for available resources (OECD, 2014^[21]). In contrast, risks with high probability and/or high damage potential need urgent action to reduce them to an acceptable level. Complex decisions regarding the acceptability of risk are routinely faced in decisions about managing water-related disasters, such as setting flood protection levels or defining flood zones (OECD, 2013^[24]). Economic analysis should inform such decisions, but ultimately, determining an acceptable level of risk in a given context is a political and societal decision (OECD, 2013^[24]).

Often it is large-scale disasters that prompt countries to revisit the acceptable levels of water-related risks implicit in their policies and measures (OECD, 2013_[25]). For example, countries commonly revisit flood protection levels following a hurricane or major storm, or address water shortage challenges during or following a major drought. However, such a reactive approach may lead to favouring areas recently affected by disasters, rather than defining an evidence-based policy at national level (OECD, 2014_[26]). Assessing water-related risks in terms of potential impact and likelihood is a useful approach to help define acceptable risk levels (OECD, 2018_[27]). Conducting risk assessment requires data and information on hazards, vulnerabilities and losses, as well as capacities to monitor, measure and model risks. As technological progress and open data policies are facilitating access to risk information, risk assessment for water-related risks become more easily accessible.

Managing water-related disaster risks: a portfolio of options

Managing water-related disaster risk reduction should involve a combination of policies that aim on the one hand at reducing existing risks (so-called corrective risk reduction measures), while having complementary measures that avoid creating new ones (so-called prospective risk reduction measures). Finally, financing, transferring or retaining residual risks can be considered. Choosing the combination of measures to invest in requires a careful assessment of the relative costs and benefits of different approaches, as well as their interactions (for example, financial instruments, if well designed, can incentivize risk reduction measures). The right mix of measures will vary and is dependent on the level of risk, funding, public awareness/perceptions and political will.

Measures to reduce existing risks

Measures that reduce existing risks can encompass structural and non-structural, or “soft” (organisational) measures, as well as include investments in the maintenance of existing infrastructure:

Structural (“hard”) measures entail investments in physical, protective infrastructure that aim at reducing the risks for communities and economic assets in areas prone to water-related hazards. Structural protective measures have traditionally consisted of engineering measures (“grey infrastructure”) and include dikes, flood gates, landslide barriers or elevated roads. Grey measures are generally cost-effective in areas with a high concentration of people and assets. For example, looking at measures to protect against coastal flooding from sea-level rise, structural interventions are cost-effective for an estimated 13% of the world’s coastline, which account for 90% of the global coastal population and 96% of global assets (OECD, 2019_[28]). However, such infrastructure measures require significant capital investments for construction and maintenance, with associated political and social challenges (OECD, 2017_[29]; OECD, 2019_[28]).

Nature-based solutions are increasingly being considered as complements, or sometimes even substitutes to “grey” infrastructure. Strategies such as retreat or limiting development in a specific area through spatial planning are often paired with the understanding that leaving a natural landscape in place, or allowing a landscape such as a wetland to regenerate, can then serve as a buffer from water-related hazards. Nature-based solutions can deliver multiple benefits beyond protection through a range of other ecosystem services which, under current cost-benefit analyses more traditionally used to assess grey infrastructure, are hard to properly monetize. These include tourism, recreation, habitat creation, transport, and cultural heritage and spiritual benefits (Mehvar

et al., 2018^[30]; Temmerman et al., 2013^[31]; Guerry et al., 2012^[32]). Explicitly valuing the risk reduction and resilience enhancement potential of nature-based solutions can encourage their integration into infrastructure investment decisions.⁶

Non-structural (“soft”) measures that aim at reducing, however not preventing existing risks include emergency preparedness measures such as flood forecasting, early warning systems or evacuation planning and emergency shelters. Such measures aim at reducing damages and losses in the event of a disaster. They have proven especially effective in reducing the loss of lives in developing countries where investments in protective infrastructure have been significantly lower compared to OECD countries. For example, after a number of deadly cyclones in Bangladesh (such as the category 5 cyclone in 1991 that killed over 140 000 people) early warning systems and emergency shelters were scaled up and resulted in a significant reduction in the number of fatalities experienced in subsequent category 5 storms.

Investments in infrastructure maintenance form an important part of measures that aim at reducing risks. Past water-related disasters revealed that under-investment in infrastructure maintenance creates additional vulnerabilities and triggers negative cascading impacts for communities and economic activities. For example, the 2013 Central Europe floods saw a number of protective infrastructure, including dams and dikes, burst, not being able to withstand the levels of floods they were initially designed to protect against (OECD, 2014^[21]). This created additional damages and losses that could have been avoided if infrastructure maintenance was consistently carried out. Maintenance also provides an opportunity to update infrastructure to be resilient to the effects of climate change.

Measures that avoid creating new risks

As previously highlighted, an important driver behind the continued trend in increasing damages and losses from water-related disasters is the accumulation of socio-economic assets and populations in areas prone to water-related hazards. Trends in urbanisation, which spark the concentration of economic activities, have contributed to this, as have protective infrastructure investments, whose sense of safety has often led to an increase of asset creation in newly protected zones. Measures that avoid the creation of new risks are therefore crucial complements to risk reduction measures.

To avoid the increasing exposure and vulnerability to risks, a concerted effort is needed by governments. Public and private investments in urban development, infrastructure, and other sectors must factor in water-related disaster risks to limit locking in future risks, which includes climate change considerations. Governments have multiple tools to ensure water-related disaster risks are mainstreamed into sectoral investments. The more “direct” measures that aim at avoiding risks include land use and urban planning, which may inform potential relocation or resettlement measures, building code or other types of sectoral regulations (OECD, 2018^[33]). The more “indirect” measures focus on communicating risks, improving hazard zone and risk mapping as a basis of knowledge for applying the more direct measures, and also aim at inducing ‘behavioural change’ among investors and the public itself.

⁶ See, for example, further discussion of natural assurance schemes utilising nature-based solutions in (Denjean et al., 2017^[42])

Whereas structural investments are by and large funded by governments, risk avoidance measures have a much lower upfront cost for the government, but can entail significant indirect costs for other stakeholders, including citizens, communities, or business owners, for example through the decrease in property values caused by hazard zoning. Policy considerations should take account of the distributional impacts of such measures.

Rules and procedures around the disbursement of public funding for risk reduction can influence the types of measures to invest in. For example, if national funding is only available for structural measures, this can influence and unnecessarily circumscribe the range of risk management available for local authorities. In Germany, federal and state funding predominantly goes towards the establishment and maintenance of dikes, which can “crowd out” other policy options (Hooijer et al., 2004^[34]). In the United States, federal financing for prevention measures through programmes such as coastal resilience grants is directed towards hard infrastructure, meaning that nature-based solutions remain uncommon despite their potential local benefits (OECD, 2019^[28]).

An important opportunity for avoiding the re-creation of existing risks or the creation of new risks is the recovery and reconstruction phase following a disaster. The so-called “*building back better*” principle is the idea that assets that were destroyed during a water-related disaster should not just be built back in the same way in the same location. Governments should set the enabling environment to ensure *ex-post* investments become an opportunity to avoid replicating existing risks, and take into account principles of risk reduction (both physical and organisational). The World Bank estimates that building back better could provide benefits in terms of avoided losses worth US\$173 billion per year, or the equivalent of 31 percent of current well-being losses due to natural hazards (World Bank, 2018).

Financing Residual Risk

The fiscal impacts of water-related disasters on government’s budgets can be lessened through developing pro-active financial management instruments. These instruments provide financial protection, as they can reduce costs by redistributing risks across time, or by transferring risks to those better able to absorb them (OECD, 2015^[35]). Specifically:

- *Risk financing instruments* involve the retention of risks combined with the adoption of an explicit financing strategy to ensure that adequate funds are available to meet financial needs should a disaster occur. Such financing can be established within the government budget through the accumulation of funds set aside for future use or obtained externally through pre-arranged credit facilities.
- *Risk transfer* involves the shifting of risks to others who, in exchange for a premium, provide compensation when a disaster occurs, ensuring that any financing gap that might emerge is partially or fully bridged. Risk transfer may be obtained through insurance policies or capital market instruments such as catastrophe bonds. For example, in Mexico, the natural disaster fund (FONDEN) has secured approximately USD 400 million in reinsurance coverage to provide a source of funding for the reconstruction of public assets and public housing after a disaster occurs.

Both instruments can reduce financial vulnerability, by avoiding potentially devastating drops in welfare and ensuring that resources are available for rapid response, recovery and reconstruction, including important post-disaster investments in risk reduction. The design of risk financing and transfer instruments can influence investments in prevention.

For example, the establishment of risk-based insurance premiums can incentivise households to reduce their own risks so that they can access cheaper insurance (Surminski and Thieken, 2017^[36]).

Aligning policies and financing approaches to improve incentives for ex-ante investments in disaster risk reduction

Governments' financing mechanisms for disaster risk reduction and *ex-post* disaster assistance have a crucial influence on other actors' engagement in disaster risk reduction. For example, the broad availability of *ex-post* compensation may reduce the incentives for households and sub-national governments to invest in *ex-ante* risk reduction or risk transfer and may ultimately increase the eventual costs of financial assistance and compensation provided by the government (OECD, 2016^[4]). Similarly, high standards of physical or financial protection can create inappropriate incentives for continuing developing hazard-prone areas (OECD, 2014^[37]).

For disaster risk reduction to be effective, it is important to recognise that it is a shared responsibility and requires the contribution of national and subnational government actors. Non-governmental actors, such as households, businesses and investors also play crucial roles in either undermining or reinforcing the government's efforts in reducing risks.

Central governments, through designing the disaster risk financing mechanisms, have an important steering function to align incentives in favour of disaster risk reduction. For example:

- *Cross-governmental cost and benefit sharing mechanisms*: most governments have cost sharing mechanisms in place between central and subnational governments as well as between central government funding agencies and other sectoral agencies affected by water-related disasters. In many OECD countries, subnational governments finance more than half of the costs of disaster risk reduction measures, while they are also responsible to finance the costs associated with recovering and rehabilitating damaged infrastructure assets. Good practices are emerging, in which central governments (such as Australia) have provided higher levels of contributions to subnational governments for rewarding forward-looking investments in risk reduction (e.g. building back better measures). There are also opportunities for governments to work across ministries and levels of government to combine investments that deliver multiple benefits, such as flood protection, water quality improvements and recreation.
- *Compensation for damages and losses incurred by households and businesses*: while governments recognise their important responsibility in ensuring the health and safety of its citizens in response to disasters, policies for providing financial disaster assistance to citizens and businesses can undermine disaster risk reduction efforts in the longer run. There are opportunities to reward efforts of those stakeholders that invest in self-protection ahead of when disasters hit.

Mobilising additional sources of finance

A number of options can be considered to mobilise additional sources of funding and finance to contribute to disaster risk reduction. In general, priority areas for governments to facilitate private action in disaster risk reduction include data and information, institutional arrangements, policies, economic incentives, and communication, knowledge and

technology (ICF, 2013_[38]). Looking specifically at mobilizing commercial finance, governments can work towards⁷:

- Developing and communicating infrastructure plans to help investors to identify investment opportunities. In addition to a developing a pipeline of *bankable* projects that have an attractive risk-return profile for investors, these plans should provide a strategic view of how these investments contribute to delivering benefits for water security for the community over the long term.
- A strategic approach to investment planning can support the development of sequenced packages of investments or investment “pathways” (OECD, 2018_[39]). These adaptive pathways should be (re-)aligned with policy objectives over time and adjusted to changing external conditions. Investments that avoid expensive path dependency or lock-in to a given trajectory can provide more flexibility to adjust to changing conditions. For example, the Delta Programme in the Netherlands Programme combines a long-term perspective, an iterative decision-making cycle, and a dedicated fund to guide and implement investments for flood protection (OECD, 2018_[39]).
- Improving systematic reporting and disclosure of physical climate-related risks by asset owners and operators. Notably, the recommendations of the Task Force on Disclosure of Climate-related Risks (TCFD) have given greater impetus to such efforts. Improved disclosure can help to motivate action to manage those risks by the private sector and inform investors’ decisions (OECD, 2018_[33])
- Ensuring that public procurement processes are conducive to reducing risks by considering the lifetime costs and benefits of alternative approaches to infrastructure provision. There are now some examples of the management of climate-related risks being considered within Public Private Partnership (PPP) contracts. One example is the requirement for increased insurance coverage in recent road concessions in Colombia, which are intended to reduce potential government liabilities if risks materialise (OECD, 2018_[33]).
- Making water-related investments more attractive to investors through (1) integration with other projects, such as urban development (2) developing long-term projects to allow investors to reap benefits from on-going operations, (3) improving scalability; (4) using policy instruments to capture the value of investments in risk reduction and provide a revenue stream for investments (e.g. via value capture mechanisms); (5) improving valuation, metrics, and standards to provide a clear performance metrics for investors (including impact investors); and (6) enhancing the calculation of benefits by using a multiple-dividends approach including the unlocking of development potential and wider social and environmental co-benefits not traditionally factored in currently.

The use of blended finance is another promising option, defined as the strategic use of development finance (e.g. official aid and philanthropic funds) for the mobilisation of additional sources of finance towards sustainable development in developing countries, has a role to play in scaling up finance for water-related investments. Blended finance aims primarily at de-risking

⁷ Options indicated below draw on discussions at meetings of the Roundtable on Financing Water and related analytical work. Further information is available at <http://www.oecd.org/water/roundtable-on-financing-water.htm>.

investments in order to crowd-in additional commercial finance that is not currently invested for development outcomes. Blended finance instruments can help to adjust the overall risk-adjusted return of investments. These include mechanisms such as investment funds (also referred to collective investment vehicles (CIVs), or syndicated loans and stand-alone instruments, which include equity, debt or mezzanine investments directly invested in companies, projects or governments. On-going OECD work is exploring how blended finance instruments and mechanisms can be used to improve the risk-return profile of different types of water-related investments.⁸

⁸ Further background on the OECD project on blended finance for water and sanitation investments can be found at <http://www.oecd.org/water/Background-Paper-3rd-Roundtable-Financing-Water-Blended-Finance-for-water-related-investments.pdf>. The final publication will be launched at the Stockholm World Water Week 2019.

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