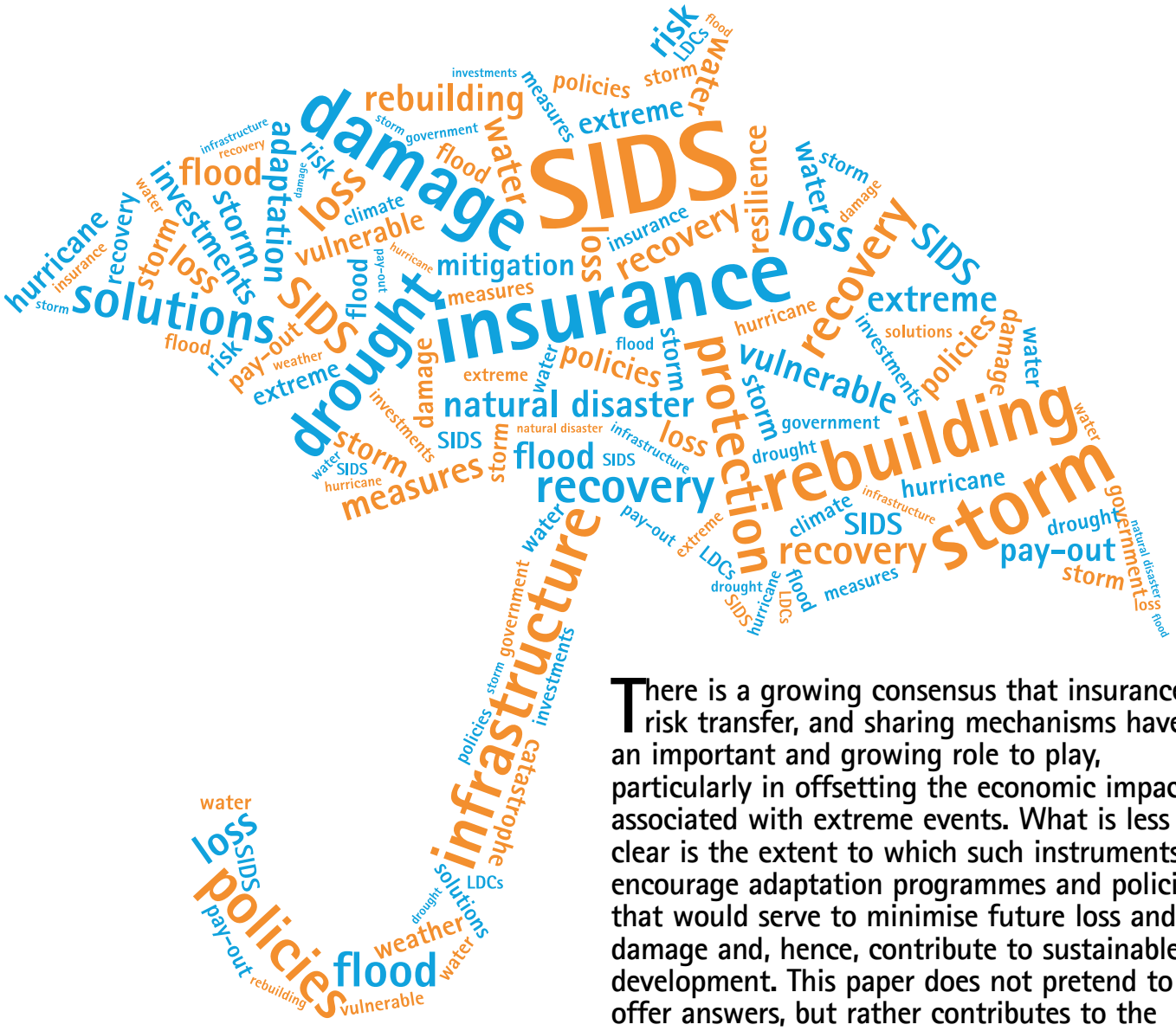
PERSPECTIVES PAPER

Global Water Partnership

Climate insurance and water-related disaster risk management

– Unlikely partners in promoting development?



There is a growing consensus that insurance, risk transfer, and sharing mechanisms have an important and growing role to play, particularly in offsetting the economic impacts associated with extreme events. What is less clear is the extent to which such instruments encourage adaptation programmes and policies that would serve to minimise future loss and damage and, hence, contribute to sustainable development. This paper does not pretend to offer answers, but rather contributes to the emerging discussion and brings to that discussion a water lens.

This Perspectives Paper was prepared by Adrian Cashman, Maxime Souvignet, Sandra Schuster, and Sabrina Zwick.
It is intended to galvanise discussion within the network and the larger water and development community.

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About Global Water Partnership

The Global Water Partnership (GWP) vision is for a water secure world.

Our mission is to advance governance and management of water resources for sustainable and equitable development.

GWP is an international network that was created in 1996 to foster the application of integrated water resources management: the coordinated development and management of water, land, and related resources in order to maximise economic and social welfare without compromising the sustainability of ecosystems and the environment.

The Network is open to all organisations which recognise the principles of integrated water resources management endorsed by the Network. It includes states, government institutions (national, regional, and local), intergovernmental organisations, international and national non-governmental organisations, academic and research institutions, private sector companies, and service providers in the public sector.

The Network has 13 Regional Water Partnerships, 60 Country Water Partnerships, and more than 3,000 Partners located in 183 countries.

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Foreword

Climate variability and the key water-related events stemming from such changes have always been with us. Indeed, current climate-change debates have penetrated human consciousness primarily through fears of an increased frequency of climatic events that are, for the most part, water related, such as droughts, floods, sea level rise, tsunamis, and others.

Water professionals have traditionally tried to put some statistical boundaries on these uncertain events to create a stable basis for planning investments to help people adapt to their impacts. The water managers' traditional role is to minimise the risks and costs of hazards to society by working at watershed levels using probabilistic models and methods.

Flood risk and drought risk insurance have existed in various forms in many countries, especially in more wealthy countries. Today, new forms of climate insurance products are emerging to deal with climatic uncertainty; they seek to generate more stable expectations, social stability, and security in poorer parts of the world.

Does or can insurance do so? Does climate insurance result in water investments that build resilience to events and manage the climate uncertainties that are so essential to growth and prosperity? Does it help to build flexible allocation and water sharing programmes? Are such insurance programmes most helpful as humanitarian relief, mitigating the immediate effects of climate events? This paper does not have one answer. Rather it outlines components of the worlds of insurance and water management, and invites further dialogue among these communities to answer such questions.

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Chair of GWP Technical Committee

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1 Purpose of this paper

The number of natural disasters of all types appears to have increased in the last few decades though there is some debate over the evidence for this. What is clear though is that the economic costs associated with extreme weather events have increased. For lesser-developed countries the developmental outcomes have been particularly severe. Recent research indicates that between 1990 and 2015, most economic losses resulted from flooding: around 40% of the total (Daniell, Wenzel, and Schaefer, 2016). Better flood management by governments, for example by China and Japan, seems to have resulted in reduced flood-related losses. Better disaster response and better building and infrastructure have reduced the relative costs in many developed countries. However, for developing countries the necessary regulations and investments are not in place, resulting in them being disproportionately affected when disasters do strike (UNISDR, 2010; Surminski and Oramas-Dorta, 2014).

As the global climate shifts and changes the frequency and intensity of natural disasters, they are expected to increase. It is, therefore, not surprising that there has been increasing interest among the global community in financing adaptation measures and the means to mobilise investments. In this context, there is a developing discourse emerging from recent Conferences of the Parties around loss and damage, risk-insurance facilities, climate-risk pooling, and other insurance solutions. The insurance industry is increasingly aware of the emerging challenges associated with disasters and climate change. An emphasis on loss and damage by itself runs the risk of limiting this risk to being reactive and compensatory as opposed to promoting measures that contribute to risk-reduction strategies and affirmative action. The scope for the development of products that provide an incentive for proactive policies and interventions poses a particular challenge in developing countries. This is in part due to weak and indebted economies, income disparities, and the often less than equitable provision of basic services.

Many products and initiatives have been developed, but it is not always clear what their effects have been and to what extent they prompt actions to reduce climate risks and build resilience (Gerber and Mirzabaev, 2017). It is necessary to explore the question of how climate-related risk-transfer mechanisms, including insurance, can mobilise water-related disaster risk reduction investments and, by so doing, contribute to development. As the focus is on risk transfer, this paper will cover its role in promoting actions and measures that contribute to the reduction of loss and damage caused by water-related events and, by extension, disaster risk-reduction measures that provide protection from extreme weather events. This paper does not set out to provide solutions or answers to that question. Rather, it seeks to promote a discussion between the insurance and water sectors around this question.

2 Introduction

Humans have always been exposed to hazards and risks. Arguably, the ability to think ahead and plan for future eventualities is one of the features of human development and is a risk-management strategy. Risks associated with natural disasters have generally been associated with non-human forces – the forces of nature – and, therefore, beyond human agency to control, though the effects may be mitigated. The sociologists Beck and Giddens, with whom the term 'Risk Society' (Beck, 1992) is associated, have argued that through the process of modernisation societies are now exposed to risks that are products of that process rather than non-human forces. They contend that 'manufactured' risks (Giddens, 1999) are products of an increasingly industrialised society, developments in technology, and human agency, which both produce and mitigate such risks. Climate change comes to mind. One of the features of 'manufactured' risk is that much of what we know about it comes from those with specialised knowledge (experts) rather than through direct experience. Beck (1992) held that widespread risks contain a 'boomerang' effect in as much as those who were involved in the production of the risk will also be affected by it and, at the same time, are those best placed to address the problem. It also affects those not responsible for the risk.

This has given rise to the concept of 'wicked problems' (Conklin, 2006; Rittel and Webber, 1973), which include climate change and natural disasters. So scientific and technological development have catalysed the problems associated with climate change. But, at the same time, we look to science and technology to provide the solutions or at least reduce the risk to manageable proportions. Manufactured risks can lead to global-level inequalities as well as reinforcing more localised inequalities. Here, the distribution of the risks is as much a function of knowledge of the risks as of the consequences of wealth inequalities. Together, these result in "differential access to forms of self-actualisation and empowerment" (Giddens, 1991, p.6), of which access to risk-management options including insurance would be a feature.

The term 'natural disasters' deflects us away from their manufactured nature. Disasters are only such when a natural hazard affects human lives and social well-being. A disaster does not happen unless people and infrastructure are vulnerable. Often, that vulnerability is a result of decisions around the development of the built environment and not using information at our disposal appropriately, or ignoring it. And vulnerabilities are being heightened by rapid urbanisation, environmental degradation, and climate change. In most societies there is the idea that individuals have an obligation to look out for the well-being of others, often using the state as an intermediary. Concomitant with this is the expectation that when assistance is needed, it will be provided. Quiggin (2007) observed that, "In an increasingly diverse society, this kind of social solidarity cannot be assumed to exist automatically."

In this context the role of the state is the management of the risks to society through its various institutions. However, it must be recognised that there are practical limits on the state and the forms in which it enables the management of risk, whether through state, collective, or individual actions. It is a practical impossibility to avoid the consequences of disasters and to manage all associated risks. The state therefore exercises choices that balance the extent to which it manages risks through the delivery of infrastructure with the provision of other forms of social protection and recompense. Conversely, the state through its actions also contributes to the manufactured nature of disasters through failures to address systemic socio-economic inequalities, allowing poor or inappropriate development and infrastructure, lack of capitals[1] and, in some cases, the outsourcing of its functions.[2] The gaps generated by the state, deliberately or inadvertently, in the provision of social welfare services in the face of disasters, create space for other forms of risk-transfer provision. These are opportunities that non-state transnational actors are taking up increasingly. Hence, there has been a growth in interest in the role that the insurance industry can play in climate and disaster risk reduction. In theory this should lead to a virtuous circle of better social protection interventions. How exactly this can be realised in and through interventions in the water sector is very much an emerging discussion.

[1] In this context, 'capitals' refers to the constellation of human, social, intellectual, natural, cultural, and economic capitals. The concept was introduced and discussed by Bourdieu, 1986.
[2] What some have referred to as the neo-liberal project.

3 A brief history of insurance

It seems that insurance, as a means of transferring or redistributing risk in a money-based economy, has been around for almost as long as gambling – perhaps five thousand years. There are examples of forms of insurance being practised by merchants, for example, in China, Babylon, and around the Mediterranean, as a hedge against potential losses. Merchants might take out a loan to fund their trading activities. The lender, in taking on the risks, would include a premium rate of interest in the transaction. In making the loan and taking on the risk, a lender would try to assess what the chances were of incurring a loss. Non-financial measures would be the main way in which the risks could be mitigated: sharing information, route choices, record-keeping for later analysis, splitting cargos, arming, or other forms of deterrent. The employment of these robust mitigation and adaptation measures would also have been considered by the lender in setting the rate of interest. So, there would have been an interplay between the extent to which a merchant would be prepared to invest in measures to reduce the risk and the potential reduction in the cost of obtaining cover.

The practice of separating financing from insurance components by merchant banks gradually started from the late fourteenth century and allowed the development of cover for other forms of hazards. The emergence of 'fire insurance' in the seventeenth century provides an interesting example of proactive measures and collective action adopted by insurers to minimise insured loss exposure through mitigation actions. Some insurers formed their own fire brigades to prevent or minimise the damage to properties they had insured. The flaw in the system though was that rival brigades would let a property burn once they discovered that it had no insurance policy with their company. The obvious step was for insurers to agree to pool their resources and commonly fund fire-fighters and fire prevention, though those without insurance still tended to be ignored.

Almost all forms of insurance draw on the 'law of large numbers', where it is assumed that in large, homogeneous groups it is possible to estimate the normal occurrence of common events and the accompanying losses that can be predicted with a degree of certainty. Formalised concepts of probability and the use of life tables started to be used by insurers from the mid-eighteenth century onwards leading to probabilistic reasoning based on actuarial evidence to inform insurance policies. This allowed premiums to be set according to the risks associated with, for example, age or state of health. It follows from this that an important aspect is understanding the hazards that might be associated with a given risk. Three basic types of hazard have been identified – moral hazard, psychological hazard, and physical hazard. Thus, setting premiums should be structured in such a way as to encourage loss-prevention actions and behaviours.

Over time, but especially since the mid-nineteenth and twentieth centuries, the range of aspects of everyday life covered by some form of insurance has expanded enormously. As the insurance industry grew, the scale of risk being carried increased enormously. To manage the concentration of risk, a system was created to distribute potential losses among many carriers, and so reinsurance came into being. Reinsurance also has its limits, as was realised in the aftermath of Hurricane Andrew in 1992. It was realised that if it had struck Miami the resultant claims would have threatened the fabric of the insurance and reinsurance industries. This led to the development of catastrophe bonds in which reinsurance was reinvented in the form of loans. It seems that as new challenges emerge the insurance and reinsurance industries can respond with products tailored to meet those challenges and, it might be noted, that several studies indicate that insurance does increase the resilience of national economies (Munich Re, 2016). We might note that climate change follows in a long line of drivers of innovation.

It is not just the private sector and enterprises that are active in the risk-sharing sector. Governments play a key role as a form of mutual aid arrangement, providing a range of protection and services to its individual and corporate citizens to manage risks, such as unemployment, illness, and even natural disasters. The insurance industry contributes to economic growth by facilitating the transfer of risk and minimising the financial impact of unexpected future events. In doing so it facilitates investment in what might otherwise be perceived to be risky actions. At the micro-scale, for

example, farmers in Lesotho who were able to purchase crop insurance against risks of drought were able to expand their businesses. Similarly, at the macro-scale, the North Sea oil industry may not have taken off if the London insurance market had not been willing to insure new and costly technologies that supported the development of the offshore oil industry. Insurance, it has been argued, is a key link in the investment chain.

Until recently, the growth of insurance had been premised on the 'law of large numbers'. In other words, by knowing something about the likelihood of an event and the associated consequences, the potential risk can be calculated. But when it comes to climate- and water-related disasters does the same logic hold, especially in the light of the additional uncertainty associated with climate change? It may well be possible to redefine an 'uninsurable risk' into an 'insurable' one. However, could this be done not only to offset economic disruption, but also to encourage actions that reduce the potential consequences and thus contribute to resilience?

4 Scale of the issue – disasters

In 2015, the president of the 70th session of the UN General Assembly, in the 2nd UN Special Thematic Session on Water and Disasters, stressed the importance of climate-risk insurance to mitigate water-related disasters. In her address to the 3rd UN Special Thematic Session in July 2017, the Netherlands' Minister of Infrastructure and the Environment stressed the importance of good water management saying, "After all, 90% of climate adaptation is about water".

According to the Insurance Information Institute, in the period 1980–2016 global losses from catastrophes as uninsured losses to governments, companies, and people amounted to at least 70% of the total losses (US$3.1 trillion). Figures produced by Munich Re's NatCatSERVICE indicated that between 1980 and 2016, 90% of disaster events were weather related and 80% of economic losses were related to weather extremes (floods, droughts, and storms). Insured losses from weather-related events have risen from US$5.1 billion per year for the period 1970–1989 to US$27 billion annually since 2000. During 2016, Munich Re reported that of the global losses of US$175 billion, 31% were due to storms (meteorological events), 32% to flooding and mass movement (hydrological events), and 10% to extreme temperatures, drought, and wildfires (climatological events). Of the US$175 billion costs of these events, only 28% was insured, with insurance for storms making up 50% of the total, hydrological events 18%, and climatological events 12%. The trend in overall losses is rising, though the trend in insured losses is not keeping pace (Munich Re, 2017). An analysis of disaster losses (Bouwer, 2011) concluded that increases in exposure and wealth were the most important drivers for the increase in disaster losses and that no study had identified changes in extreme weather due to climate change as the main driver. Indeed, the study concluded that, in the historic record, losses were likely to be related to large natural variability, cautioning that observed short-term trends could be misinterpreted as evidence of anthropogenic climate change. However, losses caused by convective events have risen even after normalisation; thus, climate change is detectable. The study highlighted that factors such as rapid urbanisation, increasing population densities in vulnerable areas, and increasing affluence are having a significant effect on the level of losses being experienced. However, it is likely that as the effects of climate change become more evident, the intersection of increases in the number and severity of climate-related hazards and anthropogenic changes (e.g. affluence and urbanisation) will lead to increased losses.

The International Monetary Fund (IMF) in a 2016 report (IMF, 2016, p.8) reported that during 1950–2014 the economic cost of natural disasters was equivalent to 13% of gross domestic product (GDP) for small developing states[3] as compared to less than 1% for other countries. It also noted that, whereas for other countries the proportion of the population affected was 1%, for small states it was 10% (see Table 1).

[3] Small developing states include: Antigua and Barbuda, The Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Suriname, Trinidad and Tobago; Bhutan, Fiji, Kiribati, Maldives, Marshall Islands, Micronesia, Nauru, Palau, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu, Vanuatu; Cabo Verde, Comoros, Djibouti, Mauritius, Montenegro, São Tomé and Principe, Seychelles, and Swaziland.

Table 1 Average effects of disasters by type, 1950–2014

	Damages (million 2010 constant dollars)		Damages as a proportion of GDP (%)		Affected population (million)	
	non-SS	SS	non-SS	SS	non-SS	SS
Drought	1,071	67	1.2	2.0	12.2	35.4
Earthquake	2,231	128	1.4	12.3	0.5	2.0
Extreme temperature	1,357	3	0.8	0.5	1.3	0.7
Flood	577	37	0.4	3.1	0.7	5.5
Storm	756	100	0.7	16.1	0.7	11.2
Volcanic activity	173		0.8		0.2	6.7
Wildfire	575	32	1.1	14.5	0.3	0.4
Other	178		0.8		0.1	1.0
Average	**849**	**87**	**0.7**	**12.9**	**1.1**	**9.8**

Source: IMF (2016).
SS: small developing states

objectives in a timely manner.

The IMF study (2016) noted the following:

- Annual damage over the last 25 years averaged 1.8% of GDP for small states as compared to 0.4% of GDP for other countries and this is likely to be an underestimate as the figures are based on reported information
- EM-DAT[4] data indicates that, whereas for larger states only 1% of disasters created damages equivalent to 30% or more of GDP, for small states it is 9% of disasters
- Natural disasters have a clear temporary impact on economic growth and fiscal balances are adversely affected, worsening external trade balances
- Climate change is expected to impose broader persistent costs on economies, with small developing states being at risk and highly vulnerable. The economic costs for small states are projected to be at least 15% of their GDP, potentially boosting poverty and migration
- Studies indicate that with a 2°C rise in global temperatures, water runoff available for drinking and irrigation could decline by 30% in Latin America and the Caribbean, and by 50% in sub-Saharan Africa.

By 2030 the climate-related risks could cost emerging economies up to 12% of GDP (Swiss Re, 2010). An example of the potential impact is highlighted by a case study of New York and the increases in flood heights (Garner et al., 2017) that would have a major impact on the costs associated with flooding. The United Nations Framework Convention on Climate Change (UNFCCC) (2007) estimated that by 2030 an extra US$9–11 billion per year would be required as additional investment for the adaptation of water-supply systems to the effects of climate change. A further US$11–12 billion per year would be required for adaptation to sea level rise. Not included in this would be the need for

[4] EM-DAT is a database maintained by the Centre for Research on the Epidemiology of Disasters, Université Catholique de Louvain, Belgium.

additional investments for the adaptation of wastewater and sanitation services, which, given the current level of underinvestment, are likely to be as high as, if not higher than, those for water-supply services.

The effects of natural disasters on the economies of small developing states are likely to increase because of a combination of factors, such as urbanisation, population concentration, and climate change. The damages and losses are already having a significant effect on the resources of governments, diverting resources away from development towards recovery. In contrast to developed economies where there are various forms of insurance cover available and penetration levels are high, developing countries do not enjoy such benefits. In Africa in 2016 (Munich Re, 2017) as much as 99% of the losses from disasters were uninsured. Under such conditions, the ability of governments to invest in increasingly needed adaptations, which are designed to lessen the consequences on social well-being, infrastructure, and economic activity, is often severely curtailed – contributing to continuing vulnerability. It is also clear that water-related catastrophes account for a significant proportion of all disasters including floods of various sorts, droughts, windstorms, slides, and wave and storm surges (Adikari and Yoshitani, 2009).

5 Global initiatives

During the past years, climate insurance has gained a significant amount of attention at the international level. Many global processes and initiatives contain insurance aspects, especially in the context of adaptation to climate change. The following section gives a brief overview on these processes and their implementation status.

5.1 The Conference of the Parties (1995–ongoing)

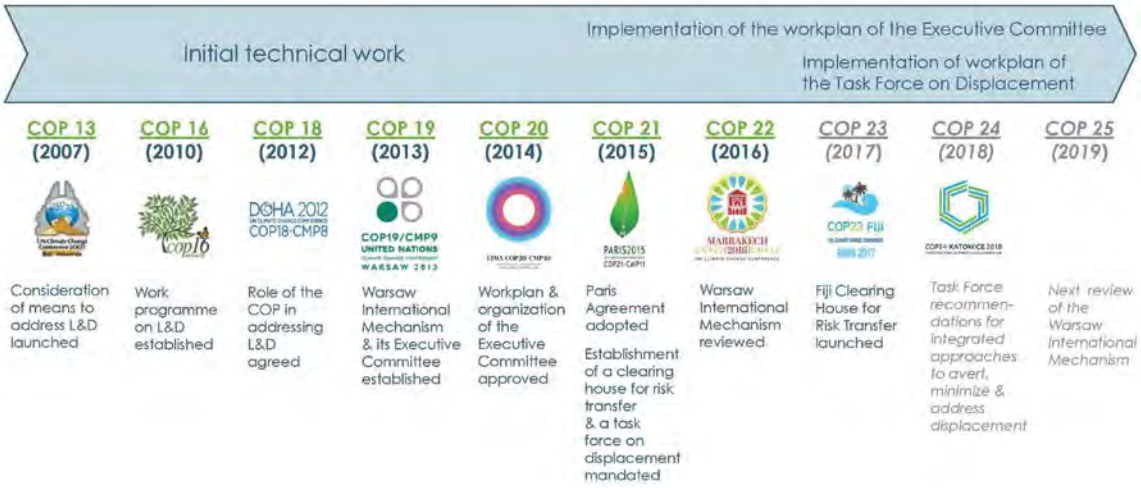
The Conference of the Parties (COP) is the highest decision-making body of the UNFCCC and meets once a year. In 2015, during COP21, the **Paris Agreement** was reached with ambitious goals for climate change mitigation and adaptation.[5] With regard to climate insurance, Article 8 of the Paris Agreement explicitly mentions "risk insurance facilities, climate-risk pooling, and other insurance solutions" as areas of cooperation and facilitation to enhance understanding, action, and support with respect to loss and damage.[6] On 22 April 2016 the Paris Agreement opened for signature and by the end of the day, 175 world leaders had signed the agreement.

Furthermore, in the **COP21 Decisions** related to the adoption of the Paris Agreement, the COP "requests the Executive Committee of the Warsaw International Mechanism to establish a clearing house for risk transfer that serves as a repository for information on insurance and risk transfer, to facilitate the efforts of Parties to develop and implement comprehensive risk management strategies," (UNFCCC, 2016, p.8).

In 2016, COP approved the indicative framework for the five-year rolling work plan of the Executive Committee as the basis for developing corresponding activities, starting in 2017 (see Figure 1).

[5] At COP21 in Paris, it was reported that over 90% of the voluntary actions for adaptation put forward were investments in water.
[6] See http://unfccc.int/paris_agreement/items/9485.php

Figure 1 Chronology – loss and damage (L&D)



Source: UNFCCC (2017)(http://unfccc.int/adaptation/workstreams/loss_and_damage/items/7545.php).

5.2 The Sendai Framework for Disaster Risk Reduction (2015–2030)

The Sendai Framework is the outcome of stakeholder consultations that were supported by the United Nations Office for Disaster Risk Reduction (UNISDR) at the request of the UN General Assembly and adopted by UN Member States in March 2015. It is a voluntary, non-binding agreement covering the period 2015–2030 with the following objective: "The substantial reduction of disaster risk and losses in lives, livelihoods, and health and in the economic, physical, social, cultural, and environmental assets of persons, businesses, communities, and countries."[7] The Sendai Framework identified the need for focused action at the local, national, regional, and global levels, and across sectors and the formulated four priority areas. The Framework acknowledges that climate change is one of the drivers of disaster risk and it recognises the importance of private sector involvement. Priority 3 highlights the need for investments in disaster risk prevention and reduction and "to promote mechanisms for disaster risk transfer and insurance, risk sharing and retention, and financial protection, as appropriate, for both public and private investment in order to reduce the financial impact of disasters on Governments and societies, in urban and rural areas," (UNISDR, 2015, p.19).

Box 1 Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts

At COP19 (November 2013) in Warsaw, Poland, COP established the Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts (Loss and Damage Mechanism). The Mechanism would address the loss and damage associated with the effects of climate change, including extreme events and slow onset events, in developing countries that are particularly vulnerable to the adverse effects of climate change.

The implementation of the Loss and Damage Mechanism is guided by the Executive Committee under the guidance of COP. The Mechanism has the following functions:

- **Enhancing the knowledge and understanding of comprehensive risk management approaches to address the loss and damage associated with the adverse effects of climate change**
- **Strengthening dialogue, coordination, coherence, and synergies among relevant stakeholders**
- **Enhancing action and support, including finance, technology, and capacity building, to address the loss and damage associated with the adverse effects of climate change.**

For more details see: http://unfccc.int/adaptation/workstreams/loss_and_damage/items/8134.php

[7] See http://www.unisdr.org/we/coordinate/sendai-framework

5.3 The G7 initiative InsuResilience (2015–2020)

The InsuResilience initiative was launched by the G7 in June 2015. The objective of the initiative is "to increase by 400 million the number of people in the most vulnerable developing countries who have access to direct or indirect insurance coverage against the negative impact of climate change related hazards by 2020 and support the development of early warning systems in the most vulnerable countries," (InsuResilience, 2016). It aims for a close partnership between the G7 and the developing countries and recognises the importance of including civil society, the insurance industry, and development banks as partners. The initiative specifically targets the poor and most vulnerable populations. During the Paris climate negotiations in December 2015, the G7 states pledged US$420 million for InsuResilience. This allowed InsuResilience to extend existing insurance schemes and, for example, to support the expansion of the African Risk Capacity (ARC) to other countries and to complement existing insurance products. The InsuResilience Secretariat in Bonn became operational in August 2016.[8]

5.4 Munich Climate Insurance Initiative (2005–ongoing)

The Munich Climate Insurance Initiative (MCII) is a leading innovation laboratory on climate change and insurance. MCII is recognised among governments and policy processes, like UNFCCC, the International Strategy for Disaster Reduction's Hyogo Framework, and in humanitarian work on climate-risk management. MCII is a node among practitioners and scholars for the innovative uses of risk-transfer tools to manage climate risks. MCII develops innovations in two ways:

1. MCII pioneers concepts through its extensive network of experts advocating for new ways to apply insurance to complement risk management and adaptation
2. MCII tests risk-transfer tools in 'lighthouse' projects and provides proof of concept and implementation models for further replication.

MCII feeds its results back to governments and decision-makers, affecting regulations and enhancing international aspirations and standards. To provide this cutting-edge professional expertise, MCII works closely with private sector insurers and insurance associations, governments and regulators, delegates to UN policy processes, UN agencies and regional bodies, and scholars and practitioners of risk management and adaptation.

5.5 The 2030 agenda for sustainable development (2015–2030)

In 2015, countries adopted the Sustainable Development Goals (SDGs) to end poverty, protect the planet, and ensure prosperity for all as part of the 2030 agenda for sustainable development. The SDGs are set for the timeframe 2015 to 2030 and consist of 17 goals and 169 targets. The intent is to engage everyone – governments of developed and developing countries, the private sector, civil society, and individuals. Insurance is mentioned under Target 8.10: "Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance and financial services." Furthermore, climate insurance can contribute to several other targets, including, but not limited to, the following:

- By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social, and environmental shocks and disasters (Target 1.5)
- Significantly reduce the number of deaths and the number of people affected, and substantially decrease the direct economic losses relative to GDP (Target 11.5)
- Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries (Target 13.1).[9]

[8] See https://www.bmz.de/en/issues/klimaschutz/climate-risk-management/g7_initiative_klimarisikoversicherung/index.html
[9] See http://www.un.org/sustainabledevelopment/sustainable-development-goals/

5.6 Funding

The Green Climate Fund is now fully operational and has raised US$10.3 billion as of March 2017. It supports the implementation of the Paris Agreement and provides funding for large-scale climate change mitigation and adaptation projects in developing countries.[10] Furthermore, with a total of US$550 million, the InsuResilience initiative mobilised a significant amount of funding for climate-risk insurance (InsuResilience, 2016). As part of the 2030 Agenda for sustainable development, several financing approaches were discussed and encouraged during the 2015 Addis Ababa conference, 'Financing for development to support the achievement of the SDGs'. For disaster resilience, commitments were made to scale up international cooperation and assistance (UN, 2015).

5.7 What next

As shown above, risk transfer and insurance solutions are increasingly represented on the international agenda. According to Warner et al. (2015), "the Paris outcomes mark a milestone in climate policy, and a milestone in thinking of climate change in a risk management paradigm." Several other processes could be mentioned relevant to climate-risk insurance, such as the World Humanitarian Summit, the G20, and the growing awareness and interest in developing countries – see for example Results UK, 2016, pp.20–21. The international political momentum is clearly there, the challenge is now to successfully implement existing strategies and commitments, and to reach out to vulnerable populations. Mobilising adequate funding and private sector involvement will be key to success, especially in view of ensuring the sustainability of insurance solutions, but also for conducting pilot projects, to raise awareness and build trust.

6 The basics of risk-transfer mechanisms and insurance

There is a large range of insurance-related products and instruments and this section provides a general overview. In addition to this introduction to risk-transfer solutions, examples and initiatives for the water sector are highlighted. However, for these products and instruments to work there has to be the right enabling environment and an understanding of the respective roles of government and regulator.

6.1 An introduction to risk transfer

Extreme weather events, such as droughts, floods, hurricanes, and storms, are increasing in frequency and intensity. In doing so, they place significant stress on societies and natural systems. Often, adaptation measures are not designed for extreme events and there are limits to what such measures can achieve. Under these circumstances, risk-transfer solutions, such as climate-risk insurance, increasingly appear as feasible ones. However, catastrophe risk-financing frameworks need to be highly specialised according to the type of coverage required and the local risk and social conditions. In this section, the basics of risk transfer and the main types of catastrophe risk financing are described.

6.1.1 Traditional insurance

Insurance is a contractual transaction that guarantees financial protection against potentially large losses in return for a premium. If the insured experiences a loss, then the insurer pays out an amount related to the loss as previously agreed. Insurance is common across most developed countries and covers many types of 'perils'. For example, many homeowners buy fire and theft insurance to protect their property and, in some countries, car owners are required to purchase automobile liability insurance. In developing countries, insurance is less widespread, often hardly present.

[10] See http://www.greenclimate.fund/partners/contributors/resources-mobilized

6.1.2 Reinsurance

Reinsurance is a process whereby an insurance company transfers all or part of its risk to another entity (the reinsurance company) for a given premium. From time to time, the total value of claims may be larger than the premium collected by the insurance company for a certain line of business or a region and sometimes altogether. Reinsurance is (not solely) a way for an insurance company to smooth the balance sheet. If the losses or debts are very large, there is a chance that the net worth of the company would not be sufficient to honour all debts. Even before the debt of a company is larger than its net worth, its survival might be at stake. It is to avoid such risks that insurance companies take out policies with reinsurance companies as well as generally to smooth the balance sheet of the insurer. Insurance companies use the support of reinsurers when they do not have the capacity to provide cover on their own. It happens especially in the case of extreme catastrophe risks.

Box 2 Moral hazard – adverse selection

Moral hazard occurs when someone increases their exposure to risk when insured. In other words, insurance companies are worried that protecting their clients from risks (like storms or flood) might encourage those clients to behave in riskier ways (like driving during an extreme event or not properly securing their property). Such problems may discourage those companies from protecting their clients as much as the clients would like to be protected. In either case the result is that the right amount of protection is not provided, resulting in what economists might refer to as an inefficient solution.

Economists distinguish moral hazard from adverse selection, another problem that arises in the insurance industry. This is caused by *hidden information (adverse selection)* rather than by *hidden actions (moral hazard)*.

Adverse selection refers to a situation where demand for insurance is correlated with the insured losses. An example of this would be an individual who smokes buying health insurance from a company that does not vary price according to smoking status. From a public policy viewpoint, some adverse selection can also be advantageous. Adverse selection may lead to a higher fraction of the total losses for the whole population being covered by insurance than if there were no adverse selection (Thomas, 2008).

6.1.3 Micro-insurance

Micro-insurance is typically targeted at lower income individuals and is also characterised by low premiums (or coverage). Micro-insurance tends to be provided by local insurance companies with some external insurance backstop (e.g. reinsurance). Micro-insurance can cover a broad range of risks although it has to date rather specialised in covering health and weather risks (including crop and livestock insurance). Weather insurance typically takes the form of a parametric (or indexed-based) transaction, where payment is made if a chosen weather index, such as the 5-day rainfall amount, exceeds some threshold. Such initiatives minimise administrative costs and allow companies to offer simple, affordable and transparent risk-transfer solutions.

Box 3 African Risk Capacity (ARC)

The ARC is a specialised agency of the African Union and was established in 2012. Originally comprising 22 member states, the number had increased to 32 by 2016. Its financial affiliate, ARC Ltd, is a mutual insurance company and was established in 2014. It provides parametric insurance with premiums paid into the insurance pool. Because of its low operating costs and a focus on events occurring more frequently than once in five years, it can provide lower premiums to countries. Members are required to have an approved contingency plan, signed off with the ARC before they can be part of the risk pool. Contingency plans consist of an Operations Plan and a Final Implementation Plan, submitted by national governments before a pay-out, and includes information on how the ARC pay-out is to be used given a specific situation. The process identifies the optimal use of funds given existing national risk-management structures, food security, and the needs of potential beneficiaries. Plans are developed collaboratively between the national governments, as in-country partners, and the ARC Secretariat. Pay-outs are not used for general investment, but to protect the livelihoods of beneficiaries who would be more negatively affected if they had to wait for assistance.

Countries select the amount of risk they wish to retain and the financing they would want from ARC for droughts of varying severity. Other hazards, including floods, may be included later. Operational plans are a prerequisite for participation and consider the existing mechanisms, priorities, and needs of each participating government. These plans are evaluated by the ARC Board's Peer Review Mechanism. As a drought risk management system, the payments, triggered by early warning through the risk modelling system, reduce the costs arising from delays in providing relief and allow a more timely response to food insecurities, based on a measurable index which triggers pay-outs.

The insurance pool reinsures itself as well as benefiting from investment income, which builds and protects the capital available for coverage to member governments.

6.1.4 Risk pooling

Risk pools aggregate risks regionally (or nationally), allowing individual risk holders to spread their risk geographically. By spreading risks, pooling allows participants to gain catastrophe insurance on better terms and access collective reserves in the event of a disaster. An example is the ARC, which allows African governments to purchase coverage for drought and/or inundation. If an event occurs which triggers a pay-out, then the funds are to be used to compensate those affected by the event to ensure that the potential adverse impacts on livelihoods are minimised.

6.1.5 Insurance-linked securities

Insurance-linked securities, most commonly catastrophe (cat) bonds, offer an avenue to share risk more broadly with the capital markets. Cat bonds are issued by the risk holder (usually a government or insurance company) and trigger payments on the occurrence of a specified event. This event may be a specified loss or may be a parametric trigger, such as the wind speed at a location.

6.2 The role of government and regulators in risk-transfer products

Insurance is traditionally operated by the private sector. However, beyond the fact that it is one of the most regulated financial sectors in many countries, successful climate insurance demands the inclusion of many different actors. For this reason, government institutions have an important role to play. They provide support to develop the market for innovative extreme-weather insurance and adapt the regulatory and institutional frameworks so that climate insurance products can be promoted. Nevertheless, certain challenges are related to this objective and certain prerequisites need to be met.

Products such as parametric index insurance and micro-insurance are relatively new and many countries do not yet address weather-based index insurance. However, this is a growth area for insurance with a variety of products that have come to the market, particularly related to the agricultural sector covering crops and livestock, to a lesser extent fishing communities, and the

health and social sectors. They are being offered not just by the insurance industry, but also by bodies such as the World Food Programme. There is an increasing body of literature on weather-based or parametric insurance that is exploring both the benefits and the challenges in the application of such schemes. The literature highlights that such insurance is not per se the solution to all the trials and tribulations experienced by all participants. The insurance regulations often do not make provisions for specific agents for micro-insurance. This limits the role of the distribution channel regarding product delivery and capacity development measures.

Financial inclusion is also a pre-requisite to sustainable growth and development. Access to financial services, coupled with instruments such as insurance, can help to buffer vulnerable low-income populations from economic shocks and, as a result, increase social resilience in the long run. Micro-insurance is characterised by small premiums to serve low-income customers – a market segment that is largely unexplored and underdeveloped. Consequently, there is a need for significant investments in increasing financial literacy. Who should shoulder this responsibility is a sensitive question. If undertaken by the insurance industry it might be perceived as making business out of the poor. There are suggestions that this should be done by a neutral player – the state or civil society organisations that understand the usefulness and importance of insurance and financial risk reduction. It can also be noted that there are examples of projects (e.g. projects supported by MCII and Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH [GIZ]) where reinsurance companies are participating in climate-risk insurance projects by offering financial literacy seminars.

In many countries, existing regulatory and legislative frameworks do not offer an enabling environment for the growth of micro-insurance. To expand, these frameworks need to appropriately include micro-insurance to strike a balance between financial inclusion and market growth.

To answer these challenges requires closer cooperation and an open exchange with the regulators to facilitate the delivery of insurance. In addition, a steady flow of information and transparency, as well as capacity development measures (participation in conferences, dialogues, and expert group meetings) have resulted in a greater awareness of the development of micro-insurance and the financial inclusiveness agenda. Finally, it seems important to encourage the exchange of experiences between the regulatory authorities and their counterparts in other regions, as well as facilitating awareness raising regarding the role of insurance in managing climate risks.

Box 4 Indemnity-based and index-based insurances

Indemnity-based insurance is a form of insurance designed for protection against claims arising from specific events such as misjudgement, failure to perform or errors and omissions. It is sometimes called professional liability insurance.

Index-based (parametric) insurance is a contract in which a pay-out is triggered when some threshold is reached, such as a measurement of rainfall or temperature at a defined weather station during an agreed period of time. The premise is that the level of pay-out is correlated to the losses incurred by policy-holders and that all policy-holders within the area covered receive pay-outs. The attraction is that it does away with the need for the on the ground assessment of the losses. Index-based insurance has been applied at different scales from the sovereign to the micro-insurance scale.

6.3 Message

The need for close cooperation between the private and public sectors has been highlighted as well as its potential benefits. However, despite the existence in many countries of an enabling environment, climate risk,[11] or more correctly, weather-related insurance, shows relatively low penetration rates and many users still lack confidence in its benefits. In this regard, measures such as climate literacy and awareness raising seem crucial. Further limiting factors and adding to this lack of confidence are the quality of the data and a lack of understanding of base risks.

[11] Climate risk insurance is a facilitative mechanism which provides support against the loss of assets, livelihoods and lives due to climate-related risks. It does so by ensuring effective and expeditious post-disaster financial support at an individual, community, national and regional level. We understand climate risk insurance as products that cover losses and damages caused by extreme weather events, which are intensified and increased in frequency by climate change (Schaefer et al., 2016).

Box 5 Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI)

PCRAFI is a joint initiative of the Geoscience Division of the Secretariat of the Pacific Community, World Bank, and the Asian Development Bank, with financial support from the Government of Japan, the Global Facility for Disaster Reduction and Recovery (GFDRR) and the African Caribbean Pacific-European Union (ACP-EU) Natural Disaster Risk Reduction Programme, and technical support from AIR Worldwide, New Zealand GNS Science, Geoscience Australia, Pacific Disaster Center (PDC), OpenGeo, and the Global Facility for Disaster Reduction and Recovery (GFDRR) Laboratories. PCRAFI provides Pacific island countries (PICs) with disaster risk modelling and assessment tools. It also engages in a dialogue with the PICs on integrated financial solutions for the reduction of their financial vulnerability to natural disasters and to climate change. The initiative is part of the broader agenda on disaster risk management and climate change adaptation in the Pacific region. The Pacific Disaster Risk Assessment project provides 15 countries with disaster risk assessment tools to help them better understand, model, and assess their exposure to natural disasters.

Since 2016, PCRAFI has provided Pacific island states with insurance against tropical cyclones, earthquakes, and tsunamis. Vanuatu, Tonga, the Marshall Islands, Samoa, and the Cook Islands were the first policy-holders to join PCRAFI in 2016. Germany, Japan, UK, and USA collaborated with the World Bank Group and the PICs to found PCRAFI, which is now expanding to include additional countries. New products will also be developed with the support of InsuResilience.

Source: http://pcrafi.spc.int/

7 Emerging thinking on climate risk and insurance

With the intensity and frequency of climate-change related extremes set to increase, is it fair to shift the burden of coping with the ensuing consequences onto developing countries that are least responsible for climate change? Using insurance-based approaches as a means of adaptation and poverty reduction risks imposing a further burden on those least able to afford the premiums and least able to reduce their losses (Surminski et al., 2016). The limited experience to date with climate insurance does suggest that it can contribute to resilience, but only as part of a wider adaptation strategy, not as a stand-alone solution.

Insurance can play a role in encouraging countries to reshape the way risks are managed. The fact that there is a link between the level of risk and the cost of insurance should act as an incentive to encourage risk reduction and foster more structured decision-making around ex ante risk. It can encourage the development of prevention-focused risk-management measures and risk-reduction behaviour. At the political level, the attachment of eligibility criteria for insurance, such as contingency planning, has had a positive effect (Schaefer and Waters, 2016). However, climate-risk insurance can only be effective as part of a holistic approach to resilience building and risk reduction. Therefore, it is essential that insurance is incorporated in an integral approach to disaster and climate-risk management (Le Quesne et al., 2017). Climate-risk insurance is increasingly being seen as one of the available tools that can contribute to resilience to climate change and climate variability, as evidenced by, for example, the Paris COP in 2015. Broadly speaking, risk-insurance instruments fall into one of two categories – weather-indexed micro-insurance and disaster insurance, and sovereign risk pooling. There are emerging insurance-based products in both categories. For example, several regional pooled schemes have been established, such as the ARC, the Caribbean Catastrophe Risk Insurance Facility (see Box 6), and the Pacific Catastrophe Risk Assessment and Financing Initiative. The intent is to build resilience through insurance in three ways – by acting as a safety net, allowing the taking of smarter risks to boost productivity, and encouraging the reduction, sharing, and management of risk.

However, underlying how resilience is to be fostered there are many questions that must be addressed. Fundamentally these revolve around the extent to which

governments can, should, and are able to address the disaster aspects of risk reduction, crisis handling, and risk sharing vis-à-vis the insurance industry (Eilers and Lawrence, 2009). In other words, to what extent are catastrophic events a private problem or a public matter? In most developing countries, insurance penetration levels are so low that that, by default, they are a matter for governments to deal with. With the advent of risk-pooling approaches there is the sharing of risk between government, the insurer, and the reinsurer, based on the principles of risk-based pricing, group balance, and the limitation of risk exposure. There is a further question as to whether the insurance product covers just reimbursement of losses or real risk management, which would include research and further loss prevention (Eilers and Lawrence, 2009). As already outlined, the scale of the problem is enormous. A recent report by the World Bank (Hallegatte et al., 2017) indicated that a failure to build resilience to climate change impacts could push an additional 100 million people into poverty. The report suggested a need to mobilise private sector climate financing that integrates climate risk and expands the use of risk mitigation and blended finance.

7.1 Challenges mobilising investment

As our understanding of potential impacts improves, the need for climate change resilience becomes increasingly important (UCISL, 2016). It should be noted that the insurance industry is gradually becoming involved in climate change mitigation through divestment from carbon intensive assets, but, at the same time, it is not a natural investor in resilient infrastructure. It has been argued that the insurance industry would be an obvious source of funds for investing in resilience as it would lead to lower claims and higher profitability, and create additional market opportunities. Insurers can reinforce the desirability of resilience by prioritising resilience investments and include these as desirable characteristics in their investment asset portfolios. Thus, the industry, not just through its policies but by its own investment decisions, could influence investment behaviour in financial markets (UCISL, 2016). There is a gap between the surplus savings in more affluent societies, the massive investments in infrastructure required, and the need to mobilise public sector investment. This, according to Allianz, is an opportunity for the insurance industry through its investments (Barysh et al., 2014).

The challenge, though, is that high levels of government indebtedness in most developing countries no longer allow public-debt driven delivery to build urgently needed infrastructure (WEF, 2016). Given the demand though, one of the questions has been how third-party financing can be encouraged through risk mitigation. This, in turn, raises the question as to where are the risks that affect investors' decisions to invest in infrastructure. Interestingly, climate-change risks do not feature; instead they are construction risks, commissioning risks, operational risks, transfer risks, and macroeconomic, political, and regulatory risks. Among the regulatory risks identified are inappropriate policies and conditions that exacerbate climate-related risks, such as lack of planning controls. Policy tools that encourage or mandate good practices and resilience can complement insurance and point to the need for the industry to engage with policy-makers (Kunreuther, 2016). As one insurance industry risk officer put it, as underwriters, insurance companies must work with the consequences of severe weather from climate change, so they are an important industry in terms of informing policy-makers, either in the public or private sectors.

Notwithstanding the indebtedness of many governments, most climate adaptation investments have come from the public sector and have not sought any significant return on investment. That said, the potential benefits in terms of damage avoidance over time are significant. However, public finances are limited and will not be able to cover the scale of investment needed to avoid catastrophic risk loss in many developed as well as developing countries (WEF, 2014). Increasingly, private sector institutions are seen as being able to bridge the investment gaps, yet for this to happen there will need to be the creation of a return on investment, even though adaptation projects do not generate returns that can easily be passed on. Furthermore, there will have to be some level of public sector partnering through which to leverage or attract private capital. Understanding the risks and potential value are skills that the insurance industry has that could play a role in mobilising investments in climate-resilient investment projects.

7.2 The role of premiums

The dilemma is, how can insurance be used to encourage investment in resilience and adaptation measures? One approach, taken from building insurance, is to use the setting of the level of insurance policy premiums to leverage capital improvements in energy efficiency by offering discounts. One proposal that has been advanced is for collective action to be leveraged from discounts that are secured by premiums reduced in proportion to the achieved level of, say, mitigation or adaptation (Doncaster et al., 2017). The framework depends on the adequacy of the insurance industry's tools to build risk and uncertainty into the costs of adaptation. It also relies on ensuring that the measures adopted have the desired effect in reducing future risks and hence future costs. This contrasts with the normal practice of insurers of reactively adapting using historic data rather than simulated climate systems (Mills, 2012). As Doncaster et al. (2017, p.253) stated, "Mandatory adaptation insurance brings the long-term cost of adaptation into the present, and a market led premium relieves government of some of the burden of persuasion." The possibility of applying a similar approach at the international level has been discussed. This involves applying premium discounts to pooled risk-sharing-sharing schemes to achieve international mitigation, as effective mitigation reduces the frequency of threshold crossing. Doncaster et al., (2017, p.254) have observed that, "The current absence of any such link to mitigation represents a missed opportunity."

7.3 Catastrophe bonds

Catastrophe bonds (cat bonds) have emerged as another risk-transfer product, particularly with respect to earthquakes and hurricanes. They seek to bring the risk of natural disasters into the capital market and are used by the issuer for payments if a specific catastrophic event occurs. If it does, then the buyer can lose the entire principal. In return the investor in the cat bond receives regular interest payments, which reflect the probability of the loss of the amount invested. Cat bonds are typically in place for three to five years and are similar to parametric products that are linked to when an event reaches or exceeds a predetermined level. An advantage of cat bonds is that they spread the risk and potential losses by extending them to a wider market and larger group of potential investors (Hermann, Koferl, and Mairhofer, 2016). Total payments are limited by the size of the issued bond and not related to the loss or damage and only according to the specified risk. Cat bonds are a new instrument for transferring risk, but they have been gradually gaining ground and are predicted to grow significantly in developing countries in the future.

An alternative, which has yet to be implemented, is the conversion of cat bonds into resilience bonds. The idea being to encourage investments in risk reduction by offering lower coupon pricing reflecting an expected reduction in future losses, reducing vulnerability before disasters happen by encouraging prevention and adaptation measures (Hermann, Koferl, and Mairhofer, 2016).

7.4 Disaster risk management policies

Natural disaster management policies have three main components – risk reduction (prevention), risk response, and recovery post disaster. Some have characterised risk reduction and recovery as being substitutable, which, for developing countries, can have serious financial support implications, but this is not the case. The focus on climate-risk insurance and risk-transfer measures runs the risk of diverting investment away from resilience building and adaptation measures. This is critical because global adaptation grants to developing countries need to rise from the US$3–5 billion per year of 2013 to US$140–300 billion per year by 2030 (UNEP, 2016). At the same time, countries are diverting funds towards the purchase of climate-risk insurance policies rather than investing in pre-emptive measures (ActionAid, 2016). Investments that reduce risk result in positive outcomes for the long-term effects following a disaster (Hsiang and Jina, 2013). Such investments include early warning systems, risk modelling, hardening of infrastructure, and adaptive measures, which take into account future climate-change risks. However, recovery measures, such as income smoothing from disaster risk insurance payments as well as post disaster concessionary aid, delay consumption losses and slow down declines in national income resulting from disasters (Hsiang and Jina, 2013).

Insurance's ex ante contribution to reducing residual risk helps to lessen the financial effects of volatility and create space for investment, planning, and development activities that build resilience. At the same time a greater emphasis on risk management and adaptation allows a focus on risk assessment and the support required for such assessments. The avoidance of potential losses through better adaptation may, therefore, help reduce insurance premiums (Schaefer and Waters, 2016). Incorporating incentives for risk mitigation and climate adaptation into insurance-based products could reduce losses from disasters and pre-empt moral hazard by policy-holders (GIZ, 2015). The collecting and sharing of performance data on investments made, how they operated through post-event assessments, and what might have happened without investments could make an important contribution to the development of incentives.

7.5 Take-away points

From the discussion presented above it is clear that the insurance and reinsurance industries have roles to play in climate insurance and they can do so directly and indirectly. Their indirect role is through dialogue and influence while their direct role is through the provision of appropriate products. The extent to which development can be supported through such measures is unclear. Moreover, how this translates into the water sector appears to be even more problematic, as will be discussed later in the paper.

Insurance and climate-risk insurance need to be considered in relation to the enabling conditions present in a country or region. Increasingly, investment and development organisations are looking for risk assessments that incorporate climate risks and, as seen above, the insurance industry as a major capital investor has a role to play. There is an emerging trend among some investors to support climate mitigation efforts by de-carbonising their investment portfolio. In parallel with this, investments that support resilience and adaptation to and mitigation of climate change can be prioritised by the industry's asset managers. Infrastructure investments that do not have an assessment of climate risks should not go ahead and the insurance industry can indirectly encourage this as well as using its own knowledge of climate risk to influence decisions. This relates directly to data collected for insurance purposes that could be used to inform the design of national climate adaptation strategies, which should incorporate economic benefit–cost analyses of those strategies.

Reflection on future climate-associated risks that go beyond the short term is needed to counter the tendency of governments and insurers not to incorporate them when assessing the viability of new investments (Surminski et al., 2016). Establishing climate-risk insurance will only be viable if it is linked to the underlying risk factors and provides a means for addressing them. Otherwise they will not be viable, and the insurance industry will walk away. The insurance industry can and does engage with governments to try to ensure that there is an appropriate policy environment and regulatory controls in place that address base risk and its associated aspects, such as moral hazard, in a proactive manner. As part of an ongoing dialogue with governments, the provision of certain types of cover can be made contingent on physical- and social-resilience building measures.

It is inevitable that disasters will happen, and damage and disruption will occur. Climate and disaster risk adaptation and mitigation measures cannot prevent damage from all extreme events. Hence, the means to cope with the aftermath of events need to be provided. There is mounting evidence that the recent innovations in risk pooling and transfer, through schemes such as ARC and Caribbean Catastrophe Risk Insurance Facility (CCRIF), are playing a positive role in providing short-term liquidity support to governments alongside other forms of assistance for disaster relief and recovery. Some commentators, though, have suggested that the way in which sovereign risk pooling and transfer schemes are configured represents a missed opportunity to enhance their effectiveness (Hermann et al., 2016; Mills, 2012). They suggest that provision should be made to build in rewards for proactive risk reduction and mitigation interventions.

While the provision of short-term liquidity through sovereign insurance pooling has a direct role to play, it cannot be seen in isolation. It is necessary to invest in

mitigation and adaptation strategies that contribute to risk reduction in the medium to long term. In reducing risk, they provide a degree of confidence that encourages investment and development. Recognising this, there have been proposals that insurers and reinsurers would need to go beyond basing decisions on historical data and performance and a focus on the short term. This would require the development of approaches whereby the future benefits of current risk-reduction investments can be monetised and used to offset lower premiums that reflect a lower risk profile. There are already some examples, and, in theory, this should work, but the practicalities and acceptance still need to be explored to turn theory into practice.

Box 6 Caribbean Catastrophe Risk Insurance Facility (CCRIF)

In 2004, in the wake of Hurricane Ivan, the Caribbean Community Heads of Government approached the World Bank to assist in designing and implementing a risk-transfer programme for member governments. In 2007, the first multi-country risk pool in the world was formed, designed as a regional catastrophe fund for Caribbean governments. The purpose of the fund was to provide insurance instruments, based on policies covering earthquakes and hurricanes, to mitigate short-term cash-flow problems after major natural disasters. Its parameter-based policies allow it to pay out to governments within 14 days to help finance initial disaster responses and government functions. In 2013, CCRIF added policies covering excess rainfall. From 2015, CCRIF expanded into Central America so that it now covers 16 Caribbean member states and one in Central America. The Facility itself is made up of seven corporate entities providing expertise in the fields of risk management and engineering, hazard and risk assessment, asset management, insurance, reinsurance, and corporate communications.

The Facility was developed with the technical assistance of the World Bank and a grant from the Government of Japan. It was capitalised by contributions from the governments of Canada, United Kingdom, Ireland, Bermuda, France, European Union, World Bank, Caribbean Development Bank, and the membership contributions of participating governments. It is a non-profit undertaking with any surplus funds being used to finance such activities as scholarships, small grants, internship programmes, and the technical assistance programme. More recently, since 2013, CCRIF has begun to develop new parametric (high winds and heavy rainfall) micro-insurance products covering fisheries, agriculture, and drought. The development of these products was led by the MCII and implemented by CCRIF, MicroEnsure and Munich Re in partnership with MCII, and additional donor assistance.

CCRIF's products are annual insurance contracts with individual governments that make payments based on the intensity of an event and on the amount of loss calculated. Losses are estimated through modelling based on a particular parameter e.g. wind speed or amount of rainfall. A country risk profile is used in the hazard and exposure models to produce an estimate of losses – not actual losses, but calculated ones. A general description of the modelling is provided by Grove (2012, pp.147–148). Each country, through its Ministry of Finance, pays an annual premium directly related to the amount of risk it wishes to transfer to CCRIF and purchases coverage up to an exhaustion point, approx. US$100 million for each insured risk category. In addition, there is an attachment or trigger point, based on model losses, after which a payment is made. In other words, there is a losses band within which the policies make payment depending on the percentage of the losses a country wishes to cover. Typically, the excess rainfall coverage is lower than for the other hazards. The pooling of risk allows the capital needed for paying claims to be significantly less than for individual coverage and, in fact, CCRIF is also able to offer discounts on premiums. However, there are some countries that have difficulties with the payment of their premiums and, in these cases, they may be covered by international financial institutions, such as the Caribbean Development Bank.

As the insurance cover is purchased through finance ministries, any payments go back to that ministry to be used at its discretion. In recent years, efforts have been made to encourage governments to report on how the disbursed funds were used. Within the hazard and loss estimation models there is no mechanism for accounting for climate change, as the models are based on historic data. Country risk profiles are re-evaluated approximately every five years. It is, therefore, only retrospectively that any climate change or even adaptation effects could be factored in. Thus, there are only weak incentives, through revisions in the level of premiums, to encourage governments to engage in climate adaptation actions. The use of payments to provide short-term liquidity immediately following a disaster or to repair and build infrastructure implies that there is little scope through this mechanism, as presently configured, to promote climate-change adaptation and reduce risk exposure. In this respect, CCRIF cannot be considered as a tool for climate-change adaptation. There has been some talk that at least some of the payments made should be directed to assist national disaster management organisations. This would address some of the concerns noted by Grove (2012) that the payment of premiums diverts funding away from disaster management agencies. It is also noteworthy that the Board of Directors of CCRIF is predominantly drawn from business and economic development agencies, but not from disaster management ones. During 2017, CCRIF made pay-outs to the islands affected by Hurricanes Irma and Maria.

8 Role of climate-related risk insurance in the water sector

The role that climate-related risk insurance might play can best be understood by considering current practices and the various potential points of application. This relates to the management of risks associated with the hydro-climatological cycle and the provision of water-related services. This might be thought of as being the management of risks from water and risks to water, how these might be affected by climate change, and how, in managing them, additionality could be created that would support social and economic development and environmental services.

8.1 Insurance potential for the water sector

The variability of climate is a challenging issue to water supply and sanitation (USEPA, 2016) and to water-resource management (Brown and Carriquiry, 2007). The lack of a water supply can severely affect the economic performance of the water users, especially the poor ones, since they do not possess the means to manage climate-related risks (Brown and Carriquiry, 2007). It is not only poor countries, but also the United States of America, that face the huge financial burden of an ageing water-supply infrastructure, which has an investment need of about US$190 billion for wastewater treatment plants, pipe repairs, and the buying and installing of new pipes (USEPA, 2008).

As a response, several insurance schemes have been developed to address these financial needs. For instance, in response to the cholera outbreak in Haiti, Mercy Corps, Fonkoze, and Swiss Re have devised an insurance scheme that automatically releases a pay-out to its clients when the measured indicators of the model (e.g. rainfall) show a high likelihood of a cholera outbreak (Murphy, 2011). The project was established in 2013 and was conceived for the 50,000 female borrowers from Fonkoze and their families. It is an example of what is known as parametric insurance.

Interestingly, Brown and Carriquiry (2007) proposed a scheme called 'reservoir index insurance', which was conceived to cover the monetary needs of the water provider in times of scarce water. The system is composed of bulk water-option contracts between urban water suppliers and agricultural users with the insurance indexed to reservoir inflows. The role of the insurance is, thereby, seen as a provider of the financial means that the water supplier needs to exercise the water options. That means that the provider can regulate the water supply to farmers while compensating them financially. This type of contract seeks to strengthen common urban and agricultural water systems. The reservoir inflows, which can be observed, are taken for the simulation of the performance of the contract. However, there are practical difficulties. If the contract is based on the volumes available, then the system can be open to manipulation. If water levels are close to trigger points, then decisions to release or not can be subject to political considerations. Some experts have suggested, though, that it would be preferable for the water utility to have the permanent water right and lease water back when it did not need it. Proponents of the approach to water sharing and allocation developed in Australia believe that with a robust water accounting system and an unbundled water rights system, the carry forward of unused water can be cheaper than insurance.

Another idea concerns a double-trigger approach, proposed by Skees and Leiva (2005), that depicts the possibility of lowering payments in the event of additional inflows into the reservoir during fall or winter. In the case of water being scarce, the payments that were collected throughout the year would allow for buying water somewhere else. Such a scheme may encourage the minimisation of water losses as well as lead to the development of an efficient water market.

Further, there are other risks, such as the political risk demanded for insurance to back up the rehabilitation of almost half of the municipal water purification systems, as is the case of Ghana. There, the Overseas Private Investment Corporation (OPIC) provided US$150 million as coverage. Before the project was implemented, around 20,000 fatalities per year could be expected to be caused by dysentery and other waterborne diseases (OPIC, 2012).

8.2 *Insurance and the management of risks from water – flooding*

Here the focus is on the management of risks associated with extreme weather, in particular floods. In many parts of the developed world there exist varying forms of insurance against water-related risks, predominantly flooding, but also drought, that are available to homeowners, businesses, and other enterprises, such as agriculture. These take various forms, but can be broadly characterised as bundled private provision and add-on, or separate private policy provision, or bundled state provision and add-on, or separate state policy provision. In bundling, the price of the insurance is not related to a single risk factor, such as flooding. This means that there is significant cross-subsidisation arising from the spread of risk. Given the nature of flooding – low probability/high consequences – pricing flood risk accurately makes it problematic to insure. This situation could well be exacerbated by the changing flood risks associated with climate change (Lamond and Penning-Rowsell, 2014).

The UK flood insurance scheme has been seen as a model of public–private partnership. Here, insurance companies provide cover on the understanding that the government invests in flood-risk reduction actions. In the UK there is a requirement for those applying for a mortgage to have flood insurance. It is bundled in as much as the scheme brings together different risks (e.g. fire, storm, and flooding) and risk geographies. When the system was originally introduced, the inability to accurately assess and price flood risk meant that any cross-subsidy was hidden, and the system was considered acceptable to consumers, government, and insurers alike (Penning-Rowsell et al., 2014). This approach, though, encourages moral hazard (see Box 2) and fails to provide enough incentives for mitigation either by government or the private sector. The bundling fails to provide incentives for risk reduction (Lamond and Penning-Rowsell, 2014). Following a series of severe flood events in the early 2000s, insurers threatened to withdraw from the market and indicated that successful flood insurance was only possible if there was adequate government investment in flood protection (Paudel, 2012).

The result of these concerns was a dialogue between the national insurance industry and the government, which led, in 2016, to the launch in the UK of Flood Re to provide cover to those parties who would otherwise have been unable to afford insurance cover. This is a not-for-profit fund, owned and managed by the insurance industry after extensive consultations with the government. Flood Re is a reinsurance company, which means it enables insurance companies to insure themselves against losses because of flooding. However, some commentators have noted that there is an absence of any formal incentive mechanisms for risk reduction and a lack of linkage between risk transfer and risk reduction (Surminski and Eldridge, 2015). With advances in technology, the ability to assess flood risk and price that risk has improved significantly and is likely to drive a transition to full risk-based pricing (Penning-Rowsell et al., 2014), which could create disincentives for risky behaviour.

At the other end of the spectrum, examples of state-funded schemes with separate flood policies can be found in the USA. In the USA, the National Flood Insurance Program (NFIP) is administered by the Federal Emergency Agency (FEMA). FEMA is responsible for covering the risks while insurers play an intermediary role selling stand-alone flood insurance for which they receive an allowance. The obligatory purchase requirement only applies to homeowners in certain flood-risk zones, who have a mortgage backed by a federal lending institution (Paudel, 2012). In addition to this, if a disaster is declared by the United States President then disaster assistance is made available through various federal programmes. The existence of disaster relief is thought to reduce individual incentives to purchase insurance. The NFIP is funded by the federal government but, even so, the premiums are relatively high compared to similar schemes in France or Belgium for example. Included in the NFIP are grants to local communities for investment in mitigation measures. In other words, government plays a major role in backing the system of insurance provision. It should be noted that, because of Hurricane Harvey in 2017, the NFIP has a very large deficit and is the centre of a debate around the adequacy of its risk-premium policy.

There are many countries, even in the developed world, where flood insurance is absent or has very little market penetration. Examples of this can be found in Canada and the Netherlands. This is a consequence of either the perceived un-insurability of the risk or the existence of other sources of cover, such as state aid or compensation. Australia is an interesting case. Overall, household flood cover take-up rates exceed 90%, except in New South Wales and Queensland because of the high cost. The Mexican disaster fund, El Fondo Nacional para el Desarrollo Nacional, provides aid although it has suffered from underinvestment on the part of the state. However, since 2006, it has used catastrophe bonds as the means to fund its operations (Lamond and Penning-Rowsell, 2014).

The outlook for flood insurance, given the changing risks from climate change, is not encouraging. In the case of private provision of insurance, uncertainty and the clustering of risks attributable to climate change will increase the reliance on reinsurance and catastrophe bonds to offset unpredictability, wider extremes, and higher regional risks. But it is also likely to lead to insurance becoming increasingly unaffordable. State-backed provision is likely to face similar challenges resulting from large demands from taxpayers on a regular basis (Lamond and Penning-Rowsell, 2014). So there appears to be a strong rationale for engaging in measures to reduce flood risk and that mitigation measures are a part of prevention, insurance, and/or disaster relief schemes.

These measures include risk assessments and mapping, which are best carried out collaboratively (where possible) between insurers and governments, as both parties can draw on different sets of expertise: insurers in risk assessments and governments in prevention and mitigation programmes. Policies that focus on damage mitigation are primarily a public task as protective measures implemented by the private sector generally do not benefit the wider community. Lastly, if insurance policies were designed around risk-based premiums there would be incentives for policy-holders to take measures to minimise their risk as well as the possibility of obtaining discounts on premiums (Paudel, 2012).

However, the continuing debate around the need for mitigation, hazard prevention, and financial incentives and their scale and effectiveness suggests that the incentives are relatively weak. The UK example is instructive and illustrates the dialectic nature of the relationship between the state and the insurance industry. When profits were potentially under pressure and un-insurability was a possibility, the insurance industry was able to secure a commitment from the government to prioritise investment in flood-mitigation efforts. This supports the arguments around the role of the insurance industry in encouraging the implementation of mitigation measures put forward in Section 7.1. As Lamond and Penning-Rowsell (2014, p.8) have observed, "In the last analysis failure to recognise the potential for climate change to invalidate existing systems carries a fearful potential burden of future unprotected damages." Though they focused on the developed world the prospect for the developing world is even bleaker.

8.3 A framework for considering insurance and the management of risks from water

The information presented in Chapter 7, and the particular focus on flooding, suggests that there are potential ways in which the provision of forms of cover against extreme events can mobilise actions that can either promote adaptation, lessen exposure, or mitigate impacts. While Chapter 7 focused on insurance in broad terms, the question is how is this applicable to climate-related risks that affect the water sector? A possible approach is to consider this by using an insurability lens applied to the project or programme cycle of inception, implementation, and operation. This will focus primarily on the water sector's service-provision functions as against its water-resource management functions, recognising, though, that there are obvious interplays between these two.

8.3.1 Project inception

The recognition of climate-associated risks can most easily be built in and addressed at the project inception and formulation stages and should be one of the risks considered. In fact, requirements for the assessment of the impact on the environment (in its broadest sense) of the proposals should be explicitly taken into account to

assess the level of risk. This would encompass the nature of the hazards and the associated probabilities of occurrence, the level of exposure, whether to a specific event or to systemic risks, the consequences of loss or damage (both monetary and non-monetary), and the maximum probable losses. This could be done through a social and economic benefit–costs assessment framework.

In considering the provision of water services, such services would include the development of infrastructure works, such as dams, wastewater treatment works, groundwater abstraction schemes, pipelines, reservoirs, pumping stations, flood control works, etc. The issue here is the extent to which mitigation and adaptation to climate change and climate variability have been factored into the conceptualisation of a project or programme. Any funder or third party should consider it to be an obligation to determine the extent to which climate-associated risks have been accounted for and the measures proposed to address them at the inception and design stages. Funding can come in many forms. The provision of finance and the covering of financial risks is necessary to be able to move beyond conceptualisation. This is where the insurance industry has a role to play when considering asset investment risk and the provision of insurance cover. Climate-associated risk needs to be factored in as part of the assessment of the conditions under which cover can be made and the level of the premium. At the concept and inception stages, decisions on whether to proceed would consider the developmental benefits, particularly in the case of large public projects and works, and their effect on the economy. Here the role and interests of the investor are critical, and the insurance industry may be, but not necessarily, one of these. This would lead to the conclusion that the insurance industry could have an important role in promoting development while its direct role is probably limited in nature. It is in its indirect role, as highlighted in Section 7.1, that the insurance industry could have a stronger say by influencing the conditions and requirements that would have to be satisfied for it to be an enabling participant in the securitisation of a project's or programme's operation.

A similar, though potentially weaker, argument could be made for the construction and/or implementation stages of water projects or programmes, where there is a need for insurance against contingent risks (WEF, 2016). The argument is somewhat weaker in as much as the cover would relate to the process of construction and the risks arising from events that might result in damage, delay, postponement, or cancellation. Such events would run the gamut from weather-related to political risk with climate-related risk being very far down the list.

8.3.2 Project operation

Most of the physical infrastructure for water can be thought of as being robust and structural damage from weather events is likely to be minor. The damages are potentially far greater when the ancillary infrastructure, such as electrical and mechanical installations and equipment, are considered. If the potential impacts of weather-related events have not been designed in, or only up to a certain point, then damage will affect the functioning of the water infrastructure, which relates back to the points made in the previous section. Looking to the role of insurance, protection can be provided to cover the potential damage to infrastructure from a variety of extreme events, which would contribute to reinstatement costs. Cover would be provided contingent on an assessment of the risk and the expected damage to the infrastructure itself.

The current model of using historic data for risk and damage assessment and the issuing of limited term policies, i.e. one year, would appear to limit the potential to include future climate risk and even encourage adaptation and mitigation actions. As has been suggested in foregoing discussions, for risk transfer to be effective in incorporating the risks associated with climate change, this paradigm would have to change. It would mean investment in gathering the highly detailed information needed to price flood risk accurately, covering changing event probabilities, exposure, and the loss and damage consequences. Adopting a more forward-looking risk assessment would provide incentives for pricing future climate risks into premiums and allow for the possibility of discounts for future reductions in risk resulting from investment in adaptation and mitigation.

What the previous paragraphs have addressed – what might be called intra-project operational risk – is how

to cover loss and damage to infrastructural fabric resulting from extreme events. It relates to how a service provider can insure itself if an extreme event damages its infrastructure. Water-service providers, particularly those owned by governments, may not have cover and rely on forms of government support to assist with recovery. This suggests a loose linkage to pay-outs from sovereign risk pools. Under these circumstances with existing infrastructure, there are few existent, a priori incentives for the inclusion of adaptation and mitigation measures.

What also needs to be considered is extra-project operational risk. This includes the loss and damage to third parties resulting from a failure to provide a particular water service – water supply or wastewater management and disposal. This might not be limited to just loss and damage, but include compensation over and above the simple losses incurred. Under these circumstances a pertinent question is, which party should carry the risk? The models of flood insurance are useful in navigating this issue. The onus is on the affected party to have risk-management tools in place, insurance cover being one of those tools. But the terms of the insurance cover, in particular the premiums, are a function of the level of flood-related risk. This is contingent on measures taken over time by other parties, for example government agencies, to address those risks. So, while there may be some incentive for policy-holders to adopt measures to minimise potential damage, for the most part the policy-holders are largely limited in being able to do anything to significantly reduce their risk of flooding.

There is a further complication that may come into play when assessing the loss and damage associated with a failure of service where it is impossible to attribute a single event to climate change. This complication is the subject of ongoing debate; how to distinguish between the loss and damage being a consequence of climate or hydrological event change so that it is a climate-related risk, and loss and damage resulting from systemic failures, such as were evidenced by the effect of Hurricane Katrina on New Orleans (Priscoli and Stakhiv, 2015). Systemic risk refers to such aspects as poor management, failure to invest in maintenance and replacement, and a lack of precautionary measures and procedures. For example, in the case of bursting pipelines, to what extent would it be possible to distinguish between the effects of climate or hydroclimatic event changes on ground movements and the effects of bad operational management? Another example would be the 'failure' of the spillway of the Oroville Dam in California; was this a consequence of maintenance issues or a design that did not consider higher inflows? Under such circumstances it must be asked if it would be socially equitable for third parties to be put at additional risk. Generally, there are few if any consequences resultant on poor performance by water-service providers. In other words, this is a problem of governance within the water sector. Perhaps here too, there may be an indirect role for the insurance and reinsurance industries to engage with the water sector and for the evaluation of institutional risk to be factored into premiums levied on governments seeking cover. It is hard to see what substantive levers the insurance industry has in respect of the water sector to motivate mitigation and adaptation. The reason being that there is limited direct involvement with the water sector and mostly the involvement is with and through central government. Furthermore, where the level of market penetration of insurance products is low and there is a concomitantly higher reliance to direct government assistance, it is hard to see the emergence of the sort of dialogue and bipartisan approach that occurred in the UK example cited above.

Future risk patterns arising from climate change are going to pose an increasing challenge for the three components of a functioning insurance market – insurable risks, an insurable population, and solvent insurers (Lamond and Penning-Rowsell, 2014). While the provision of water services and the proper management of water resources are essential for economic and social development, as recognised in Sustainable Development Goal 6, the scope for climate insurance in respect of water-related disaster being an additional catalyst for development would seem to be limited. Its inclusion (bundling) in a broader package of risk-pooling and risk-transfer mechanisms, particularly at the sovereign level, would appear to be more promising.

8.4 Role of integrated water resources management (IWRM)

The potential of climate-related insurance, risk-transfer, and risk-pooling instruments that address water-related disasters and catalyse development appears to be limited.

Conversely, the application of IWRM as a supportive process would seem to be of benefit. This is particularly the case in respect of evaluating the probabilities of events occurring, understanding exposure, and being able to provide a good understanding of potential losses and damage arising from different events as well as the residual risks. At a very basic level, data monitoring and collection form the basis of understanding of the current and future effects of climate on water resources as well as understanding risks – something both the water and insurance sectors need. Monitoring and data collection is also a vital input into early warning systems, which are critical to minimising damage and loss. It goes further: proper planning takes into account future risks and uncertainty, particularly as many infrastructure projects have a long design life. This implies that climate change and climate variability have to be factored in and this has to be based on sound information as the basis for understanding what the future risk profile might be. Planning is not only a management instrument, as understood in IWRM, but is a regulatory requirement embedded in the enabling (policy and legal) environment. The importance of governance has been touched on above in relation to the systemic risks arising from poor management and bad practices. Good governance is needed to ensure that the risks associated with climate change are not exacerbated. Within IWRM the institutional framework together with the enabling environment are key elements in ensuring good governance.

One of the principles of IWRM is that water development and management should be based on participatory approaches involving all stakeholders, users, planners, and policy-makers. Some of the experiences from flood management demonstrate the necessity of stakeholder involvement and how this has shaped the provision of adaptation and mitigation measures and the related conditions for the provision of flood insurance cover. Similarly, there are emerging lessons from index-based crop insurance against drought that underline the importance of stakeholder involvement in their design and implementation.

So, it can be concluded that the adoption and implementation of IWRM approaches provide the foundation on which the provision of insurance, risk transfer, and risk pooling is based. For example, excess rainfall parametric insurance is based on the collection and analysis of weather data just as understanding flood risk is based on the outputs of hydrological models. So there is an imperative for insurance providers to engage with their water sector counterparts if they are to be able to continue to provide cover. At the same time, the water sector would benefit from a better understanding of damage and loss as an integral part of its long-term planning and provision of physical and institutional infrastructure.

9 Take-away messages

Water-related extreme events have a significant negative effect on social well-being and economic development, particularly in Small Island Developing States (SIDS) and Least Developed Countries (LDCs). Their abilities to pre-empt, prepare, and recover from extreme events is hampered by their limited resources and, particularly, their limited financial resources. Recognising this, the Green Climate Fund, for example, pays particular attention to LDCs, SIDS, and African States in promoting and funding climate-resilient development. However, it was also recognised, leading up to COP21 and beyond, that there is a role that insurance can play. Ideas and discussions around this role and addressing damage and loss in general are ongoing. Given the pivotal role of water, not just in underpinning human development, but also as a major constituent of extreme events, it is appropriate to explore the intersection of water management and risk-transfer mechanisms. This paper has set out to explore the idea of whether there is a role for climate-related insurance and water-related disaster risk management in underpinning social and economic development in SIDS and LDCs. It recognises that this is an emerging area of discussion and, as such, has not set out to be prescriptive, but rather to start a dialogue between the water sector and the insurance sector.

From the water-sector side, questions are being asked as to whether the development of programmes and actions that consider future climate changes and variability are not just a new slant on what hydrological modellers have been doing for years. There are questions around whether any of this changes the need and role of benefit–cost analyses (BCA) as a way of accounting for

future risks. In other words, it is unclear to some in the water sector how future climate change and variability changes the way in which they are to be accounted for in programmes and projects. For water-sector professionals there is a belief that the data on the loss and damage arising from extreme events, as collected by the insurance industry, could inform better BCA, though in the case of LDCs and SIDS, given the low penetration of insurance uptake, this would be aspirational rather than realisable in the near term.

As currently configured, most climate-risk, weather-related, risk-transfer instruments focus on providing liquidity in the immediate aftermath of an extreme event. They are based on prior available data, are annual in the extent of the cover provided, and, at the sovereign or sub-sovereign level, provide non-hypothecated budgetary support. It might be argued that as more data is accumulated, and the effects of climatic change and variability become more evident, these effects will be factored into the determination of risk profiles, which inform the provision of cover. As yet though, the incentives to encourage proactive adaptation to climate change and variability through risk-transfer mechanisms are weak and more work by all parties would need to be done to address this aspect – clearly an area where dialogue and innovation are required. Indeed, the evidence from existing schemes, such as CCRIF, ARC, and PCRAFI, indicates that there are few provisions to encourage investments in adaptation that would lead to the lowering of insurance premiums. That said, the likelihood is that such considerations will start to be factored into more forward-looking risk profiling.
For the water sector, in general, there are few water-specific examples of risk-transfer mechanisms involving forms of insurance built around the management of extreme events except for floods. Even with these, the incentives to promote proactive risk-reduction interventions are, at best, weak and, at worst, ineffective. However, as indicated in Section 8.4, there is certainly an important role that IWRM can play in supporting the development of insurance and other risk-transfer mechanisms that would benefit the provision of water infrastructure and the multiple services it provides. This is particularly important in the case of SIDS and LDCs. Indeed, the many examples of parametric-based insurance products would not have been possible to develop and implement without hydro-meteorological data of the sort routinely used in the water sector to support modelling, analysis, and forecasting. And this reinforces, for SIDS and LDCs, the importance of developing robust IWRM management instruments[12] such as the monitoring networks, data collection, assessments, planning, communication, modelling, and decision-making that are needed to support the design and implementation of risk-transfer instruments.

In conclusion, the insurance industry and the water sector are at the start of exploring the nature of their relationship – how they can be mutually supportive in promoting development in new ways that respond to the anticipated changes in climate and climate variability.

[12] See http://www.gwp.org/en/learn/iwrm-toolbox/Management-Instruments/

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