



THE TRIPLE DIVIDEND OF RESILIENCE

Realising development goals through the multiple
benefits of disaster risk management

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1. Executive summary

1.1 Rising disaster losses

The adverse impacts of climate change and extreme weather events are a severe threat to livelihoods, and hold back growth and sustainable development. The total number of disaster events and related economic and humanitarian losses have been increasing steadily since the 1980s. Economic losses from extreme weather events are now in the range of \$150–\$200 billion annually, with an increasing share of damages located in rapidly growing urban areas in low and middle income countries. However, despite widespread awareness of these rising losses, investment in ex-ante disaster risk management (DRM) remains relatively low.

1.2 Underestimated benefits of DRM investments

To secure development gains and help eradicate poverty in the long-run, it is critical to strengthen ex-ante DRM measures that build resilience at the household, firm and macro level. The process of disaster risk management includes (i) risk identification, which informs the design of other risk management actions: (ii) reducing risk, by avoiding the creation of new risk and reducing existing risks; prepare for the residual risk, either (iii) physically (preparedness), or (iv) financially (financial protection); and (v) resilient recovery and reconstruction, by building-back-better after a disaster.

However, existing methods of appraising DRM investments undervalue the benefits associated with resilience. This is linked to the common perception that – similar to investing in voluntary insurance – investing in disaster resilience will only yield benefits once disaster strikes. This leads decision

makers to view DRM investments as a gamble that only pays off in the event of a disaster. However, there is increasing evidence that building resilience yields significant and tangible benefits, even if a disaster does not happen for many years.

1.3 The Triple Dividend of investing in resilience

This report provides evidence for three types of benefits – or dividends of resilience – that DRM investments can yield: (1) Avoiding losses when disasters strike; (2) Stimulating economic activity thanks to reduced disaster risk; and (3) Development co-benefits, or uses, of a specific DRM investment. While the first dividend is the most common motivation for investing in resilience, the second and third dividend are typically overlooked. More specifically:

1. The First Dividend of Resilience – saving lives and avoiding losses: The basic rationale and common motivation for DRM investments is to save lives, reduce losses and promote effective recovery from disasters. While it is the most obvious of benefits from DRM investments, it is not easy to measure. This is mainly because it is impossible to predict exactly when the next disaster will strike and how intense it will be. Therefore decision makers have to trust in statistics that tell them that there is a high likelihood that in the next 20 years, a disaster will hit. However, with the short term perspective of many politicians or private investors, the immediate benefits of other investment options can appear more attractive. Therefore, it is worthwhile to also consider other more immediate benefits of DRM investments in the second and third dividends.

2. The Second Dividend of Resilience – unlocking economic potential: There is strong evidence that the mere possibility of a future disaster has real impacts on present-day decisions and economic growth: The risk of extreme weather events and disasters looms as an ever-present background risk. As a consequence, risk-averse households and firms avoid long-term investments in productive assets, entrepreneurship is restricted and planning horizons are shortened, leading to development opportunities being lost.

This report presents evidence that DRM measures that reduce this background risk can have immediate and significant economic benefits to households, the private sector and, more broadly, at the macro-economic level. For instance, there is evidence that reduced background risk and effective risk management allow poor households to build up savings, invest in productive assets and improve their livelihoods. More generally, increased resilience enables forward-looking planning, long-term capital investments and entrepreneurship – even if disasters do not occur for a long time.

3. The Third Dividend of Resilience – generating development co-benefits: Most DRM investments serve multiple purposes, and are not solely designed to reduce disaster impacts. Strengthened river embankments can act as pedestrian walkways, parks or roads; strengthened disaster early warning systems also often strengthen weather forecasting capacity, which can be used by farmers to know when to plant and harvest; or disaster shelters, can be used as schools or community spaces, when not being used as a shelter. Integrating multi-purpose designs into DRM investments can save money. These multiple uses of DRM infrastructure, as well as the associated cost-saving, can be classified as development co-benefits. While the nature of these co-benefits varies significantly, they all materialize even in the absence of a disaster and can therefore strengthen the immediate business case for investing in DRM.

1.4 Improving the business case for DRM

Understanding all three dividends of resilience and incorporating them in planning and decision making is critical for strengthening the business case for DRM investments. It will remain that the fundamental principle underpinning DRM measures will be to save lives, reduce losses and promote effective recovery from disasters. However, presenting evidence of additional dividends to policy-makers and investors can provide a narrative reconciling short-term and long-term objectives, thereby improving the acceptability and feasibility of DRM investments.

This report argues that any evaluation of the benefits of DRM investments is incomplete without a full account of all three dividends of resilience. In practice, the analysis of this ‘triple dividend’ can be integrated into a variety of different commonly used appraisal tools. Thus, this report suggests a framework for conducting more complete appraisals of DRM investments. Overall, this will help to show that – in addition to preventing human and economic losses during a disaster – DRM investments can actively contribute to wealth, wellbeing, profit, growth and sustainable development.



Glossary of key terms

Avoided losses

[1st Dividend of Resilience]

The immediate and long-run damages and losses that disaster risk reduction measures can prevent in the event of a disaster.

Background risk

The possibility of an extreme event (e.g. a disaster) that threatens the prospects of ongoing economic activity. The presence of background risk restricts long-term investments and economic growth, even before a disaster occurs.

Co-benefits

[3rd Dividend of Resilience]

Co-benefits include development benefits or uses of a DRM investment or action, in addition to the primary DRM objective of reducing disaster losses.

Development Dividend

[2nd Dividend of Resilience]

This is the development potential that is unlocked when background risk is reduced through DRM measures. This includes innovation, entrepreneurship, and investments, and is independent of the occurrence of any actual disaster.

Disaster Risk Management (DRM)

Processes for designing, implementing, and evaluating strategies, policies, and measures to improve the understanding of disaster risk, foster disaster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response, and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life, and sustainable development. (IPCC, 2012)

Resilience

The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions. UNISDR (2009). UNISDR Terminology on Disaster Risk Reduction. UNISDR: Geneva.

Risk

The combination of the probability of an event and its negative consequences. UNISDR (2009). UNISDR Terminology on Disaster Risk Reduction. UNISDR: Geneva.

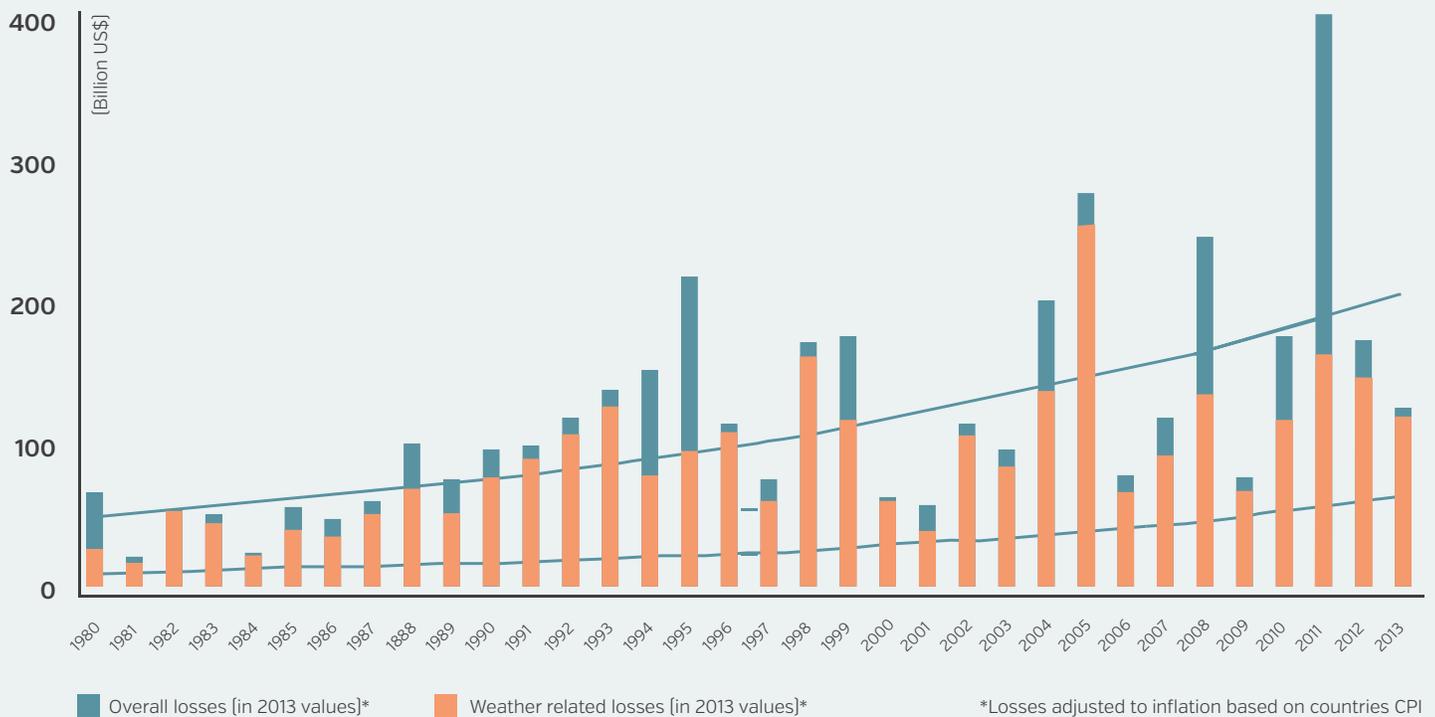
2. The case for investing in resilience

2.1 Disasters, poverty and development

There is growing awareness that disaster and climate risk threatens future growth and development. The total number of disaster events has been increasing since the 1980s, with this trend set to continue, driven by climate change, population growth, urbanisation, more people living in coastal areas and floodplains, and the degradation or loss of natural ecosystems (IPCC, 2012; United Nations International Strategy for Disaster Reduction (UNISDR, 2015a). Economic losses from ‘natural’ disasters are now reaching between \$150-\$200 billion each year, up from \$50 billion in the 1980s (see Figure 1), while projected future disaster losses in the built environment alone are estimated at \$314 billion per year (UNISDR, 2015a).

The increasing frequency of devastating disasters is a major obstacle to the reduction of poverty and promotion of shared prosperity. While progress in human development has been remarkable in the last two decades, with global levels of extreme poverty likely to fall to under 10% of the global population in 2015 (World Bank, 2015), gains have not been evenly distributed between or within countries (World Bank, 2013). Without concerted action, by 2030 there could be up to 325 million extremely poor people living in the 49 countries most exposed to natural hazards and climate extremes, the majority in South Asia and sub-Saharan Africa (Shepherd et al., 2013). Urban growth will be a particularly strong driver, with the global urban population increasing by 1.4 million each week, roughly the size of Stockholm (Global Commission on the Economy and Climate, 2015). Most of this expansion

Figure 1: Disaster and weather-related losses 1980–2013



Source: Munich Re [2013], cited in GFDRR [2015]

is occurring in low- and middle-income countries, where the growth of informal settlements amplifies disaster risk as low-income families are forced to occupy hazard-prone areas with low land values, deficient infrastructure, a lack of social protection and high levels of environmental degradation (UNISDR, 2015a).

2.2 Incentivising ex-ante DRM

A range of reports have emphasised the need to incentivise and enable greater ex-ante DRM (UNISDR, 2015a; World Bank, 2013; IPCC, 2012). A range of international policy frameworks echo this message, including the Sendai Framework for Disaster Risk Reduction, the Financing for Development Framework, the Sustainable Development Goals, and the climate change agreements. All of which highlight the importance of investing in resilience. However, it still isn't happening at a rate needed to curb rising disaster losses. Although some countries, cities and communities have made progress, funding is still heavily biased towards ex-post measures. Meanwhile, the importance of such ex-ante prevention is not yet reflected in the much of the policy and practice in governments, aid agencies, communities or businesses (Kellet and Caravani, 2012).

There are many reasons for this underinvestment in disaster resilience. These include a lack of resources in poor countries, a limited understanding of risks and impacts, greater political buy-in for more visible post-disaster support initiatives, and the ready availability of international post-disaster assistance (Keefer, 2009; Wilkinson, 2012; World Bank, 2013). In particular, DRM suffers from a lack of salience with citizens, as the benefits are hard to perceive (Wilkinson, 2012). Crucially, policy makers tend to underinvest or not invest at all in projects to manage risk because the costs of such investments are

visible and immediate, whereas their direct benefits and distribution of benefits are unclear, uncertain and distant. Existing methods of appraising investment decisions often fail to incentivise DRM because they undervalue the resulting benefit streams.

There are also reasons why individuals choose to stay and invest in risky areas (Hallegatte et al., 2015). Increased exposure to natural hazards may be seen as an unavoidable side-effect from investments to create additional employment and growth from international trade in areas characterised by low transportation costs but exposed to flood risks (Gallup et al., 1998). In China, for instance, the Total Factor Productivity (TFP) is 85% higher in coastal regions than inland, and TFP growth is not significantly different despite higher investment in inland regions, suggesting that lower transport costs offer a permanent productivity advantage in coastal regions (Fleisher and Chen, 1997). Similarly, poor people living in flood-prone areas in Mumbai are well aware of the risks and make deliberate decisions to live where they do to benefit from higher wages, better schools and medical care (Patankar, 2015).

To counter these problems, this paper examines a shift in the narrative away from a singular focus on losses as a driver for action, towards the recognition and appraisal of a broader set of dividends from investing in DRM. We argue that DRM investment should be considered within decision making as something that is good for wealth, wellbeing, profit, growth and sustainable development, in addition to preventing human and economic losses should a disaster strike. Through the use of the triple dividend concept, we examine evidence of the wider benefits of investing in resilience measures with the intention of improving awareness and stimulating the development of appraisal tools that can incorporate these factors and enhance future investments in DRM.

3. The Triple Dividend: a comprehensive business case for resilience

Investing in DRM yields a wide range of benefits in the short- and long-term: if a disaster does strike, then prior planning and investments help reduce human and economic losses. This is the basic rationale and common narrative for disaster risk management, associated with saving lives, reducing losses and supporting both individuals and communities to quickly and effectively bounce back from disasters. However, there are a range of resilience dividends (World Resources Institute (WRI), 2008; Rodin, 2014) associated with DRM investments. The risk of disasters creates background risk, which constrains investment in capital productivity and development for fear of returns being eroded by disaster events. DRM enables forward-looking planning, long-term capital investments and entrepreneurship. These are all crucial elements for economic growth and shared prosperity. Investments in DRM and resilience also generate wider social, economic and environmental co-benefits irrespective of disasters. These could include multiplier effects on employment or trade, or strengthening water and sewage systems. Importantly, many investments can be specifically designed to have a dual use, such as roads that act as embankments or tunnels that can also serve as water retention and drainage systems. As such, determining whether an investment is a DRM measure with development co-benefits or a development measure with DRM co-benefits is often a matter of perspective.

This report argues that a more complete understanding of this wide range of benefits – or dividends – of DRM investments is critical for strengthening the business case for resilience. In particular we propose three concrete dividends from ex-ante DRM measures:

1. The First Dividend ('avoided losses'). Investing in DRM strategies takes the form of reduced losses and damages in the event of a disaster. These losses and damages can be both direct and indirect, leading to both immediate and long-term effects. Most notably, the first dividend includes saved lives, along with prevented or reduced damage to infrastructure and assets. This corresponds to the conventional ex-post, loss-centric view, and is likely to underestimate the benefits of DRM measures (see section 4).

2. The Second Dividend ('unlocking economic potential'). Even the mere possibility of a future disaster has real impacts on present-day economic growth, particularly in regions or localities where disaster risks are perceived to be high. DRM measures help to manage this ever-present background risk of potential future disasters. This helps to unlock economic development potential by enabling forward-looking planning and investment. Increased resilience can catalyse innovation, entrepreneurship and investment in productive assets – even if disasters do not occur for a long time (see section 5).

3. The Third Dividend ('generating development co-benefits'). DRM investments are typically associated with economic, social, and environmental uses, or 'co-benefits'. Co-benefits can play an important role in motivating DRM measures and determining their design (e.g. shelters doubling as community spaces or flood protection infrastructure doubling as roads). While the nature of co-benefits varies significantly, they all materialise even in the absence of a disaster (see section 6).

The three dividends of resilience are summarised in Figure 2. This report is a first step to bring together evidence that helps to characterise the dividends resulting from DRM investments. These are used to build the case for an incentive structure for DRM that goes beyond avoided losses.

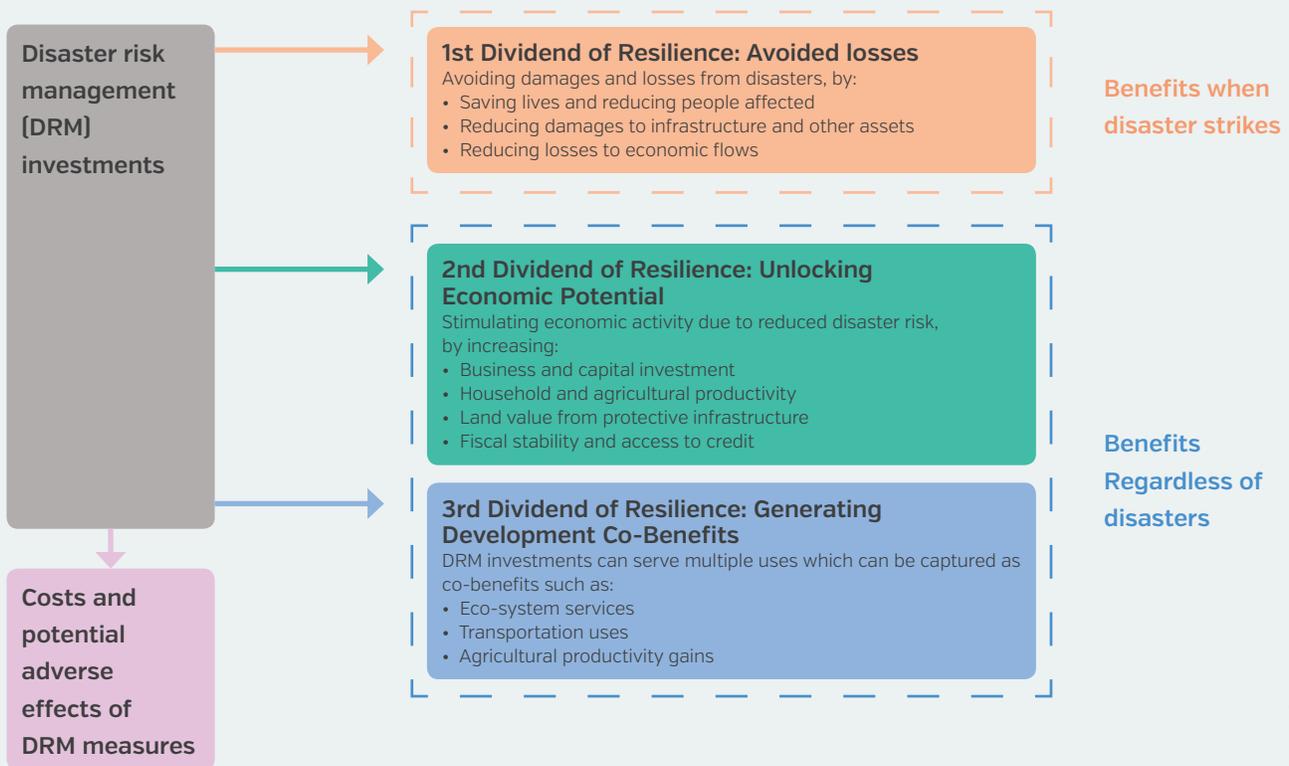
The following sections illustrate each of the three dividends of resilience in turn. For example, the World Bank and Mexico’s Ministry of Finance elaborated a joint study to determine the impact of investment in flood defence in terms of reducing flood damage in the State of Tabasco between 2007 and 2010. The first dividend was revealed by the cost-benefit ratio of these benefits, which was 4:1, contributing to avoided damages and losses when floods occurred in 2010 equivalent to \$3 billion, or 7% of the GDP of Tabasco (World Bank, 2014a). This

high ratio supports the business case of investing in DRM, but it could be further strengthened if it captured the full range of dividends associated with these investments, such as new flood defenses helping to maintain existing and stimulate new investments. For instance, continued investment by companies in the Tabasco region that were otherwise leaving further strengthens the case for avoided losses. Additionally, the second dividend is evident from reduced background risk encouraging private investment in housing in previously flood-prone areas and public investment in improved drainage and electricity networks in areas where floods had previously deterred such investment (World Bank 2014a).

In addition, the capital of Tabasco, Villahermosa, has seen improvements in the urban environment as

Figure 2: The Triple Dividend of Resilience

Investing in resilience reduces losses and damages in the case of a disaster. However, it can also yield development benefits regardless of disasters. Typically, standard disaster risk management investment appraisals fail to account for the 2nd and 3rd dividends of resilience.



a result of federal government investment in flood defence. Major DRM investments have stimulated local actors to take greater care of the environment while small-scale projects with environmental benefits have been initiated, including tree planting on riverbanks to prevent landslides, which could potentially reveal environmental co-benefits as mentioned under the third dividend. People are beginning to dispose of litter more responsibly, throwing less on the streets or into drains, helping avoid blockages during rainy season (Vorhies and Wilkinson, forthcoming 2015).

This example also demonstrates the need to examine the possible negative consequences, which could be considered negative co-benefits associated with a comprehensive assessment. For example, a report by the Colegio de la Frontera Sur suggests there are a number of unintended negative

externalities associated with the flood defence project in Tabasco. Channelling water away from the capital Villahermosa has led to increased flooding elsewhere in the state, mainly in rural areas. There have also been negative environmental impacts as a result of these large construction projects. These negative impacts also need to be considered when weighing up the full range of costs and benefits associated with a particular DRM investment. The triple dividend framework presented here helps to inform more comprehensive cost-benefit calculations.

Cyclone shelter and medical camp, Bangladesh



4. The First Dividend of Resilience: saving lives and avoiding losses

Saving lives and avoiding losses (First Dividend of Resilience)

DRM measures can avoid or reduce losses and damages (both immediate and long-run) in the event of a disaster.

These include:

- saving lives and reducing numbers of people affected
- reducing direct damages to infrastructure and other assets
- reducing economic and non-monetary losses (direct and indirect).

The triple dividend of resilience approach outlined earlier is motivated by the observation that fully acknowledging the benefits of resilience will strengthen the business case for DRM investments. However, while other benefits of DRM can play substantial roles, the primary objective of DRM remains clear: to save lives, while also reducing loss and damage to people and their assets. In recognition of the importance of this objective, this section briefly highlights the evidence for effective risk management that limits human and economic disaster losses.

4.1 Saving lives and reducing people affected

Effective disaster risk management policies and actions are often measured by their ability to save lives and reduce the number of people affected by disasters. To this effect, progress in saving lives has been marked. As reported in the 2015 Global Assessment Report, ‘improvements in disaster management have led to dramatic reductions in mortality in some countries’ (UNISDR, 2015a). In Bangladesh, deaths from cyclones have been reduced considerably, due to a combination of strengthened coastal defences, cyclone shelters and early warning systems (EWS).

While comparisons across countries and events are difficult due to contextual differences, it is possible to infer levels of preparedness and effectiveness of DRM measures through observing the impacts of similar hazards (see Figure 3). In 2010, the existence and enforcement of building codes helped limit earthquake damage in Chile, with less than 1000 people killed, despite a magnitude 500 times greater than the Haiti quake of the same year that killed over 230,000 (Lovett, 2010). More recently, increased investment in infrastructure and disaster preparedness paid off in the latest earthquake and tsunami in September 2015 in Chile, which resulted in relatively low casualties, despite a 8.2 magnitude (UNISDR, 2015b). Volcano-related mortality has also decreased significantly as a result of volcano monitoring, assessments and EWS; and, although not all volcanoes are monitored, it is estimated that such measures have saved about 50,000 lives over the last century (Auker et al., 2013).

DRM interventions can also save lives through acknowledging different people’s needs, vulnerabilities and capacities. Integrating indigenous knowledge into DRM initiatives has been shown to help avoid loss of life. For example, oral history on ocean and buffalo behaviour meant that the inhabitants of Simeulue Island in Indonesia had early warning before the Indian Ocean tsunami in

2004 and were able to retreat to the hills. As a result, only seven out of 78,000 people died from the tsunami, despite the island being located just 40 km from the epicentre of the earthquake (Lovell and le Masson, 2014).

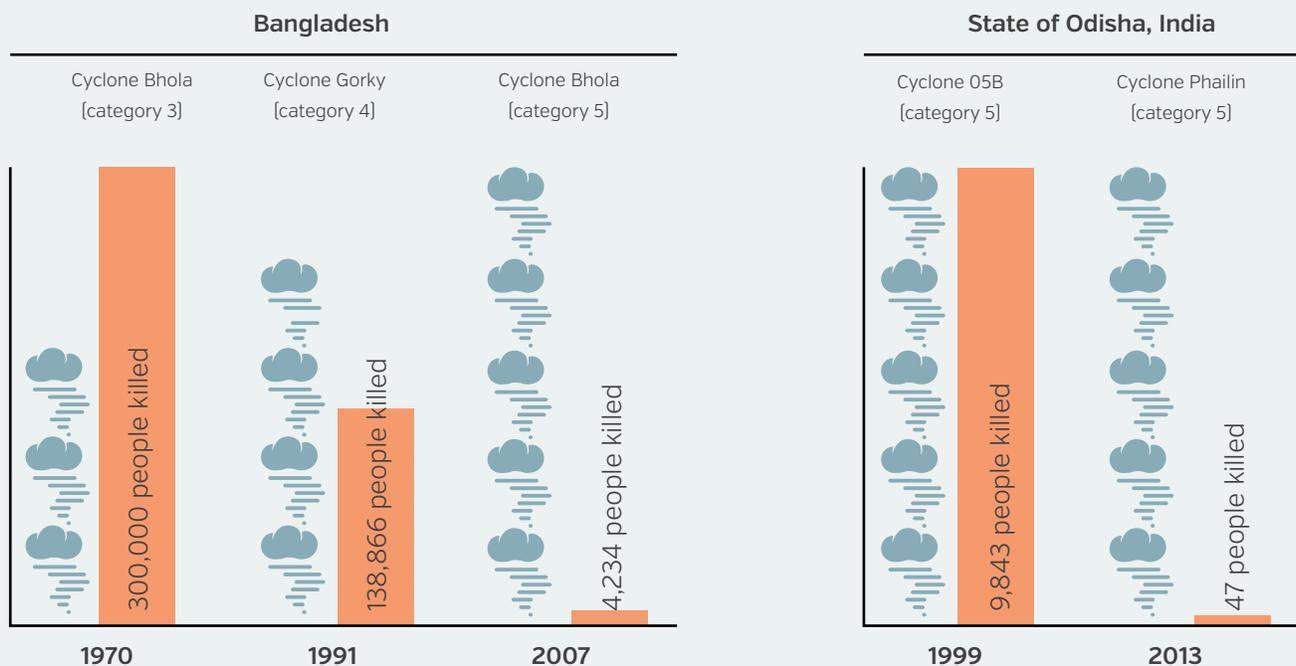
4.2 Reducing damages and losses

There is a strong body of evidence for the effectiveness of DRM measures gathered from projects around the world. The GAR 2015 concludes that ‘annual global investment of US\$6 billion in appropriate disaster risk management strategies would generate total benefits in terms of risk reduction of US\$360 billion. This is equivalent to an annual reduction of new and additional average annual loss by more than 20 percent’ (UNISDR 2015a). Mechler and Bouwer (2014) make the case that, despite the increase in risk exposure, various DRM strategies have decreased vulnerabilities throughout the world.

Infrastructure, early warning systems and planning are three areas where DRM investments have been critical in reducing losses from disasters. Infrastructure losses have particularly profound consequences for development progress. Between 2015 and 2030, approximately \$90 trillion is expected to be invested globally in infrastructure to meet the world’s urban, land use and energy needs (Global Commission on the Economy and Climate, 2014). This is particularly pertinent in Asia and Africa, where 90% of urban growth is expected to take place between now and 2050, which will result in accompanying infrastructure needs (United Nations Department of Economic and Social Affairs (UNDESA), 2014). It is crucial that these huge financial investments are disaster-resilient, as this will protect lives and secure development progress.

Infrastructure losses often go well beyond physical damage. Business losses can be the consequence of ‘ripple effects’ as the impact of shocks propagate both upstream (backward) from clients to suppliers

Figure 3: Reduced cyclone mortality in Bangladesh and Odisha, India



Source: Munich Re (2014), in GFDRR (2015)

and downstream (forward) from suppliers to clients. The 2011 Thai floods impact on global supply chains forced Toyota to slow down production in factories in Indonesia, Japan, Malaysia, Pakistan, the Philippines, South Africa, Vietnam and North America. Locating industrial parks in protected areas less prone to flooding would have improved disaster resilience and reduced losses (SCOR SE, 2013). Similarly, the Tohoku-Pacific earthquake in Japan in March 2011 reduced domestic industrial production and the exports of goods used as inputs in the auto industry, leading to a reported cut in production at Toyota's Indian subsidiary by up to 70% between 25 April and 4 June (The Economic Times, 2011).

Early warning systems are frequently cited for their role in reducing economic losses of disasters by triggering other important prevention actions, as there is more lead time to protect assets. While the evidence base is complicated by issues of attribution and lack of widespread cost benefit calculations (Rogers and Tsirkunov, 2011), table 1 suggests significant loss and damage reduction possible due to an early warning of different lead times on a number of different movable assets (Subbiah et al., 2008).

Establishing and enforcing risk-informed, locally-appropriate standards and codes for new buildings and other infrastructure reduces the risk of damage to structures in the event of a disaster. Existing infrastructure can also be retrofitted to adhere to building standards. For example, houses in Tonga constructed to cyclone standards in the early 1980s were significantly less impacted by Cyclone Ian in 2014 than many newer houses that were not built in compliance with the standard. These were completely destroyed or severely damaged (GFDRR, 2014). Similarly, homes built with typhoon-resistant features as part of the Storm Resistant Housing for a Resilient Da Nang City project in Vietnam showed no damage when Typhoon Nari hit in October 2013 (Tran, 2013).

Table 1: Damage reduction due to early warning of different lead times

ITEM	LEAD TIME	DAMAGE REDUCTION [%]	ACTIONS TAKEN TO REDUCE DAMAGES
Household items	24 hrs	20	Removal of some household items
	48 hrs	80	Removal of additional possessions
	Up to 7 days	90	Removal of all possible possessions including stored crops
Livestock	24 hrs	10	Poultry moved to safety
	48 hours	40	Poultry, farm animals moved to safety
	Up to 7 days	45	Poultry, farm animals, forages, straw moved to safety
Agriculture	24 hrs	10	Agricultural implements and equipment removed
	48 hours	30	Nurseries, seed beds saved, 50% of crop harvested, agricultural implements and equipment removed
	Up to 7 days	70	Nurseries, seed beds saved, fruit trees harvested, 100% of crop harvested, agricultural implements and equipment removed
Fisheries	24 hrs	30	Some fish, shrimps, prawns harvested
	48 hours	40	Some fish, shrimps, prawns harvested, nets erected
	Up to 7 days	70	All fish, shrimps, prawns harvested, nets erected, equipment removed
Open sea fishing	24 hrs	10	Fishing net, boat damage avoided
		15	Fishing nets removed, boat damage avoided
School or office	24 hrs	5	Money, some office equipment saved
	48 hours	10	Money, most office equipment saved
	Up to 7 days	15	Money, all office equipment, including furniture protected

Source: Subbiah et al., [2008].

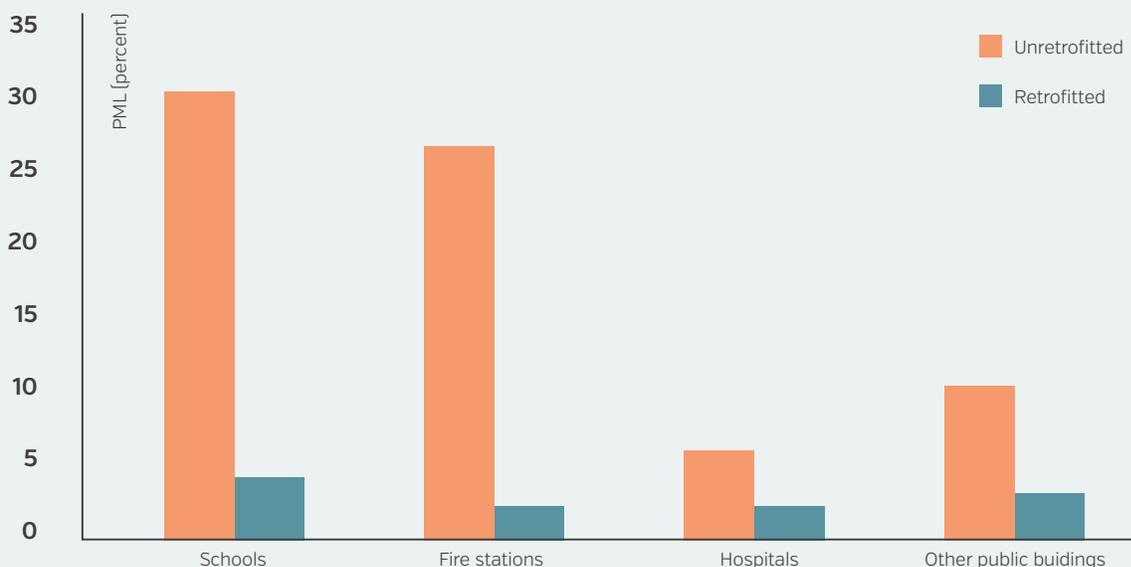
A World Bank study of earthquake vulnerability in Colombia (Ghesquiere et al., 2006) assessed a range of measures that were:

- structural (retrofitting and reinforcement of public buildings, such as schools, hospitals, fire stations and administrative buildings)
- non-structural (the resettlement of vulnerable populations in high-risk areas)
- functional (protection of people and assets, so that they remain functional during and immediately after an emergency).

A probabilistic cost-benefit analysis helped demonstrate to decision-makers the significant reductions in probable maximum loss (PML) of a 1 in 1000 year earthquake event, before and after structural investments were made (shown below in Figure 4). The average annual returns on mitigation investments for schools, hospitals and fire stations were estimated to be as high as 19% for structural investments and 32% for structural and functional investments. In addition to the direct costs of structural and functional assets, there may be significant indirect losses. One example of this would be the way disruption to education can constrain future career options and prosperity later in life.

The examples above suggest that the avoidance of loss usually provides a critically important stream of benefits for DRM investments. Widening avoided loss calculations beyond immediate asset losses to include the impact of disasters on the wider economy and society can help strengthen the case for investing in DRM. Nevertheless, the potential incentivising role is limited by several factors. First, these wider benefits are hard to identify, calculate and attribute. This is because these benefits rely on counter-factual reasoning, in that a DRM investment will reduce the probability of a disaster happening. It is difficult to measure the impact of something not happening. Second, the benefits may not be enjoyed by the same parties facing the costs of investment, although this may not be a problem for governments concerned with wider economic and social goods. However, the most critical point to consider here, from the perspective of this paper, is that using loss-based approaches to justify investment is reliant on the occurrence of a disaster event in the future, which is a major flaw. By identifying the dividends of resilience that are delivered even in the absence of disaster events, and incorporating them in decision making, the case for investing in resilience can be greatly improved.

Figure 4: Probable Maximum Loss [PML] of a 1 in 1000 year earthquake event, before and after structural investments



Source: Ghesquiere et al. [2006]

5. The Second Dividend of Resilience: unlocking economic potential

Unlocking economic potential (Second Dividend)

DRM measures that reduce the background risk due to potential future disasters can have immediate and significant development benefits. Increased resilience enables forward-looking planning, long-term capital investments and entrepreneurship, even if disasters do not occur for a long time.

These benefits include:

- economic gains from positive risk taking (e.g. entrepreneurship and innovation)
- investments in productive assets (e.g. in small-scale agriculture)
- extending planning horizons (e.g. for building up savings)
- increase in land values after DRM investment.

In disaster-prone places, risks of extreme weather events and disasters create an ever-present background risk. As a consequence, risk-averse households and firms avoid long-term investments in productive assets, entrepreneurship is restricted and planning horizons are shortened, meaning development opportunities are lost. By reducing this background risk, or by helping households and firms to manage it effectively, DRM measures can have immediate and significant economic benefits.

This section presents evidence that investments in ex-ante DRM can unlock economic opportunities for households, government and the private sector and, more broadly, at the macro-economic level. For example, the evidence from poor rural households dependent on agricultural income suggests that strengthening ex-ante DRM enables households to increase savings and investment in productive assets, thereby improving their productivity and livelihoods. Further examples show how DRM measures can increase land values, as well as improve credit access, fiscal management and public sector coordination. Overall, increased resilience can be argued to be a catalyst for positive risk taking such as capital investments, entrepreneurship and innovation, along with forward-looking planning.

5.1 Increased business and capital investment

Without effective instruments for managing disaster risks and the adverse consequences of disasters, investment decisions are likely to be excessively risk averse (Elbers et al., 2007; Gollier and Pratt, 1996). As a result, businesses refrain from engaging in entrepreneurial activities and innovation or making long-term investments in productive assets.

One of the most immediate benefits that investing in DRM has to offer the private sector relates to investment risk-taking. Taking positive risks, engaging in entrepreneurial activities, and investing in productive assets and innovation are the drivers of job creation, rising incomes, greater productivity and overall economic growth. However, the perceived risk of future disasters can lead to greater risk aversion, which dampens entrepreneurial activity (Rose, 2015). Investing in DRM can help reduce this background risk and provide better information on residual risk, which in turn helps promote the entrepreneurship and investment needed for economic growth and job creation. While risk-taking can increase welfare, there may be a trade-off between exposure to natural hazards and productivity or economic

growth in high disaster risk situations. Public and private investment in improved risk management can mitigate this trade-off, reducing the background risk that prevents people from investing, therefore improving productivity and accelerating growth (Hallegatte 2014).

Similarly, disaster insurance can encourage the kind of 'positive risk taking' that is arguably fundamental to the development process, making investments more secure and therefore fostering business innovation and growth (Hallegatte et al., 2015). However, disaster insurance may also lead to moral hazards if it is not designed with the correct control measures in place. This points to a potential counter effect of using insurance, where it can create a false sense of security, increase vulnerability to exceptional events or encourage inappropriate development in high-risk areas (Surminski 2014).

Investing in DRM can generate benefits that extend across sectors to the macroeconomic level. A region or country-wide boost to productive investments can boost the overall development of a country. Protecting coastal regions, towns, business districts or ports from flood can foster economic activity, long-term planning and capital investments. This is because, where well designed and maintained, large DRM infrastructure investments (such as dikes) can protect not only large firms themselves, but also their workers and suppliers, along with their social and logistic infrastructure. If DRM investments enable firms and their stakeholders to make long-term capital investments, engage in trade and thus promote business development, the entire area benefits collectively (World Bank, 2013; Hallegatte, 2014).

Firms may also benefit from improvements to their image and credit ratings, through increased stability (Rose, 2015). There is some evidence of businesses taking this 'good citizen' image seriously; for example, in a set of six case studies of companies describing their activities related to managing the physical impacts of extreme weather and climate change, most saw avoidance of disaster impacts (both now and in the future) as only part of the logic for investing in resilience (Crawford and Seidel, 2013). Companies such as American Water, The Hartford, National Grid and Rio Tinto all emphasised that fulfilling, or staying ahead of, regulatory and disclosure requirements and new government policy are key business drivers for investing in resilience. A survey of European companies also revealed that investing in resilience can help develop market opportunities, with 43% of the companies surveyed anticipating increased demand for existing products/services (Carbon Disclosure Project (CDP), 2015).

5.2 Household and agricultural productivity dividends

When levels of background risk are high, evidence suggests that households lacking effective risk management tools will tend to spread their overall risk. Rather than specialising, households tend to engage in a wider range of lower risk activities, thereby reducing returns to assets and investments (Hallegatte et al., 2015). For example, there is evidence that rural households avoid focusing solely on agriculture and instead diversify occupations within households as a risk management measure – with negative impacts on long-term welfare (Rentschler, 2013). While such actions reduce the risk of severe losses, they obstruct growth and incentives to invest (Dercon, 2005; Carter and Barrett, 2006).

An illustration of this effect can be provided in an agricultural context in Zimbabwe. Here, farmers exposed to risk exhibit a mean capital stock that is half as large as for farmers who are not exposed. Of this reduction in capital, ex-ante risk accounts for two thirds of the difference; hence, most of the welfare impact of risk comes through reduced investments and risk-taking, not damage and loss when a disaster occurs (Elbers et al., 2007; Hallegatte et al. 2015). Extending these findings into other decision making contexts and sectors could provide crucial evidence to enhance the incentives for ex-ante investments in DRM.

Household insurance and social safety net programmes have been observed to stimulate savings, investment in productive assets and increases in agricultural productivity in a number of different countries, with subsequent improvements in income levels. In Ethiopia, the R4 Rural Resilience Initiative (previously HARITA) programme is providing risk management support, including weather-indexed insurance to small-scale and subsistence farmers. Premiums are largely paid through labour to support risk management activities. In the event that rainfall drops below a predetermined threshold during the growing season, insurance payments are automatically triggered. An evaluation of the programme has found that insurance is enabling farmers to increase their savings, which can act as an important reserve in the case of contingencies. Moreover, insured farmers have been found to increase their investments in productive assets, in particular oxen, but also fertiliser, improved seeds and compost – thus improving their overall productivity (Madajewisz et al., 2013; Greatrex et al., 2015).

Evaluations of the Mexico government’s CADENA programme show how weather indexed insurance not only helps to compensate for drought losses, but also directly increases the productivity of small-scale farmers. The insurance programme has

Table 2: Land-value Gains and Infrastructure Costs in Recife, Brazil

SERVICE	INCREASE IN LAND VALUE (\$ PER SQUARE METER) BY DISTANCE TO CENTRE			RATIO OF GAIN IN LAND VALUE TO INVESTMENT COST
	5–10 KM	15–20 KM	25–30 KM	
Water supply	11.1	5.1	3.2	1.02
Road pavement	9.1	4.8	3.4	2.58
Wastewater removal	8.5	1.8	0.3	3.03

Source: Peterson, (2009)

enabled farmers to overcome credit constraints and mitigated previously chronic underinvestment in tools and fertiliser. As a result, farmers have been able to increase their agricultural productivity, with an average 6% increase in maize yields. Evidence also shows that insured farmers invest in riskier and higher-yielding cultivation methods, with higher overall planting-stage investments than uninsured peers, enabling them to reconcile entrepreneurial investment decisions with effective risk management (Dar et al., 2013; Emerick et al., 2015).

Overall, these evaluations demonstrate how effective risk management tools not only yield significant benefits in the aftermath of a disaster, but can also yield significant benefits even if disasters do not strike for many years, such as through increases in productivity and income levels. By reducing background risk, DRM measures can directly influence economic decisions and behaviour, actively contributing to a long-term sustainable economic development process. If implemented at sufficient scale, DRM measures (such as weather indexed insurance programmes) can have significant economic development benefits at the macro-level, and even be cost-effective in the absence of disasters.

5.3 Land value dividends from protective infrastructure

Investment in dams, levees and other structures to protect assets from disaster impacts can unlock economic potential through increases in productive investment and consequent increases in the value of land. To some extent, the efficiency of infrastructure provision can be measured by the relationship between land-value capitalisation and infrastructure costs. When the benefits of capitalised land values exceed the costs of installing infrastructure, infrastructure is generally undersupplied. This relationship can be seen in Table 2, which demonstrates land-value gains and infrastructure costs in Recife, Brazil. In this case, there is clearly a need for more investment in road pavement and wastewater removal in order to meet economic demand, as the land-value gains exceed the costs of infrastructure supply. This is in contrast to the water supply, which has an almost equal land-value capitalisation to investment cost ratio of 1:1 (Peterson, 2009).

In a similar way, protective infrastructure can also generate dividends of resilience. Hard infrastructure for protection, along with soft DRM measures, such as monitoring and early warning, can protect assets from disaster impacts. These factors are likely to have a positive effect on land prices, which also shows an increased willingness for people to invest in these areas, given a reduced background risk. These increased land values can in turn help to raise government revenue, helping to finance the cost of ex-ante DRM measures. It is possible to learn from building development projects, where one of the most common strategies for recovering infrastructure costs involves the sale of land with enhanced value. Here, it can be seen that the business case for protective infrastructure investments can be more accurately costed in this way, particularly where the public sector owns the land.

5.4 Fiscal stability and future credit risks

There are a number of economic and other benefits of DRM to be recognised and realised by those in charge of fiscal policy decisions. Approaches organised around the protection of the balance sheet using risk financing instruments have seen growing emphasis in disaster-prone countries in recent years (Mechler et al., 2015). The inclusion of disaster risk in these instruments and shock-financing mechanisms can have a significant impact on reducing uncertainty, potentially unlocking higher private investment, employment and growth (Griffith-Jones and Tanner, 2015). Implementing a structured process for risk detection in the balance sheet can potentially provide a ‘price signal’ while, in contrast, a focus on ex-post disaster management offers little in the way of risk awareness or stimulating risk reduction (Phaup and Kirschner, 2010). This is the case in Mexico, where innovative financing arrangements have been initiated under FONDEN incentivise investment, to ‘build back better’ and relocate housing to lower-risk areas (Hoflinger et al. 2012).

One example of a strategic DRM response that incorporates the ‘triple dividend’ concept is the fiscal risk matrix. Such matrices combine the assessment of many different contingent risks, including their interaction with disaster risk, and their use has grown from insights gained during recent financial and fiscal crises (Mechler et al., 2015). Fiscal risks are ‘stress-tested’ through sensitivity tests on baseline macro and fiscal indicators. There is also a growing understanding of the need to take a systematic perspective for understanding the potential for complex and interrelated shocks, leading to a multi-risk approach (World Economic Forum (WEF), 2015). Disaster risk has come to be considered a key threat; in a recent survey regarding relevant fiscal risks in OECD countries, disasters emerged as an important concern (Kopits, 2014).



In the future, the benefits of lower background risk may also be reflected in businesses and governments' access to affordable credit. Noting the growing influence of climate change on risks, Standard and Poor's suggest climate change could feed through to sovereign creditworthiness through economic, fiscal and external performance (Standard & Poor's Rating Services, 2014). Credit rating agencies have also recognised that companies' credit profiles may be determined to a larger degree in the future by climate-related disasters and the increased exposure of companies and their global supply chains to risk (Standard & Poor's Rating Services, 2015; Moody's, 2015). In some cases, credit rating agencies have explicitly called for DRM strategies to both prevent disaster losses and maintain credit ratings, illustrated in coastal cities in south-eastern Virginia's Hampton Roads region of the USA (Moody's 2015). Access to credit to

enable capital investment may therefore provide a component of the development dividend for firms, with ratings agencies now calling for greater disclosure of firms' exposure to extreme natural hazards, which should encourage them to bolster their resilience to these events and aid transparency (Standard & Poor's Rating Services, 2015).

Ram Kumari Tharu, 33, heads out to a local collection center with her morning cucumber harvest.

6. The Third Dividend of Resilience: Co-benefits of DRM investments

Generating development co-benefits (Third Dividend of Resilience)

DRM investments have multiple uses and can be classified as economic, social and environmental co-benefits. These co-benefits may either be explicitly designed into the investment (such as dual-use infrastructure) or incidental.

While the nature of co-benefits varies significantly, they all materialise even in the absence of a disaster. Co-benefits can play an important role in motivating DRM measures and determining their design. Multi-purpose design that intentionally integrates these co-benefits can save money and significantly improve the attractiveness of investing in DRM.

These co-benefits include:

- economic co-benefits, (e.g. flood protection supporting fisheries)
- social co-benefits, (e.g. improved transparency or social cohesion)
- environmental co-benefits (e.g. watershed protection).

Table 3: The range of co-benefits associated with DRM measures

DRM ACTIVITY	POSSIBLE CO-BENEFITS
Flood protection structures	Provision of irrigation or potable water and hydro-electric power. Dual-purpose road infrastructure
Strengthening DRM capacity of civil society	Improved governance, more organised social structures
Eco-system based DRM approaches	Environmental conservation, improved air quality, climate change mitigation
Shelters	Community facilities (e.g. clinics or schools) in non-disaster periods
Improving water supply systems in rural areas	Water supply systems improved regardless of a disaster occurring
Construction and use of drainage pipes, canals and water retention basins	Improved irrigation practices, possibly improved agricultural practices. Dual purpose road tunnel or parking lot infrastructure
Community-based disaster preparedness	Improved women's involvement in community level activities
Installing more resilient wireless communications	Enhanced access to telephony and electronic data services
Training farmers to diversify the use of crops	Reduced vulnerability to poverty
Better monitoring of food supplies	Improvement to the food supply chain, possibly making it more cost-effective

Source: Adapted from Environmental Resources Management and Department for International Development (ERM), 2005

To gain a complete picture of the benefits of DRM investments, their social, environmental and economic contexts must be taken into account. This makes it evident that DRM measures can yield a variety of co-benefits. These can materialise even in the absence of a disaster, but – unlike the second dividend of resilience – are not due to reduced background risk. In line with growing efforts to highlight the co-benefits of climate change mitigation, it is critical for decision makers to fully understand and account for the co-benefits of DRM and climate change adaptation measures (Vorhies and Wilkinson, 2015; Kok et al., 2008; Santucci, 2015; Global Commission on the Economy and Climate, 2014). As emphasised in section 4, it is important that the design of DRM measures must also fully consider and mitigate the potential negative side-effects of DRM measures (such as the costs of relocation of communities from risky areas).

This section presents evidence of the positive side-effects, or co-benefits, of DRM measures. Some of these might be unintentional and generated as ‘spill-over’ effects. However, the examples below also demonstrate the diverse synergies that can be created by intentionally designing measures to deliver both DRM and development objectives. Conversely, linking with DRM goals can also help to deliver other benefits that might otherwise be undersupplied, such as public space or improved transport networks.

Multi-use design is becoming increasingly common in physical DRM infrastructure, where high upfront costs might otherwise make the investments harder to justify. Cyclone shelters in Bangladesh have a long history of multi-purpose design for use outside storm times (Khan, 2008). In Tinputz District, Papua New Guinea, resilient infrastructure for education and health is designed both as a space for communal gatherings and safe shelters for the community if disaster does strike (Tinputz District Disaster Risk Management Committee, 2014).

Table 5 presents examples of the breadth of these co-benefits, illustrating how widely they can vary in practice. Some co-benefits can be directly observed, measured and quantified, such as livelihood benefits or dual purpose infrastructure, while others, such as social cohesion, can be very hard to quantify and integrate in economic analyses, despite being potentially significant. Below, we outline three areas where DRM activities are delivering co-benefits: ecosystem-based approaches, transport systems, and agricultural projects.

6.1 Ecosystem-based co-benefits

Ecosystem-based approaches to DRM and climate adaptation provide a good illustration of co-benefits from investing in resilience. These have gained popularity in recent years emphasising how good stewardship of environmental systems can help reduce and adapt to disaster risks, in turn saving lives and reducing loss and damage. At the same time, ecosystem protection can generate wider social and environmental co-benefits, even in the absence of disaster events. These include:

- biodiversity conservation
- carbon sequestration and mitigation
- land erosion and degradation prevention
- habitat creation and restoration
- mitigation of microclimate variability.

Social co-benefits include:

- improved and secure livelihoods
- social cohesion and community
- new or preserved recreation areas
- better quality land for agriculture/livestock
- better water security.

Aside from economic damages, these approaches have been shown to help develop new or improved income, profits or savings, when compared to alternative DRM or climate adaptation approaches (Doswald et al., 2014). The services delivered by ecosystems can therefore deliver, not only disaster risk reduction benefits such as flood regulation and protection from storm-surge protection, but also enhance food security, provide sustainable water supplies or enhance livelihoods through increasing resource-use options or tourism (Jones et al. 2012).

A Vietnam mangrove plantation and DRM project in the typhoon and flood prone coastal provinces of northern Vietnam has proven to have significant environmental co-benefits (IFRC, 2012). The benefits of this multi-purpose DRM project include: carbon sequestration, nutrient retention, sediment retention, biodiversity habitat, flood attenuation, wastewater treatment, and water supply and recharge. The 17-year-long project cost \$8.88 million to set up and has involved the creation of 9,462ha of forest (8,961 ha of mangroves) in 166 communes and the ‘protection of approximately 100km of dyke lines’. The project aims to reach approximately 350,000 beneficiaries directly and two million indirectly. There has been an ‘increase in per hectare yield of aqua culture products such as shells and oyster by 209-789 per cent’. Economic benefits from aqua product collection and honeybee farming are found to be between \$344,000 and \$6.7 million in the selected communes. Environmental benefits include \$218 million alone generated as an estimated minimum of CO₂ emissions absorbed by the planted mangroves (assuming a price of \$20/t CO₂e).

Such multi-purpose water management approaches can therefore be designed to provide livelihood, environment, aesthetic or recreational co-benefits alongside disaster resilience. The Netherlands ‘Room for the river’ is being designed to manage higher water levels, giving the country’s rivers more space to flood safely. The measures also attempt to improve the quality of the immediate surroundings, such as providing new river islands. While in some cases such co-benefits can be assumed to represent good project design and implementation, they are not always costed into the business cases that justify the financing decisions.

Similarly, the World Bank’s flood management programme in Sri Lanka’s capital Colombo demonstrates the wider value of wetland protection and restoration beyond just flood defence. Whilst performing a valuable role in reducing flood risks, the wetlands of the Colombo basin serve a range of other purposes. They provide livelihoods and economic security to local residents through fishing and rice cultivation, while also serving as

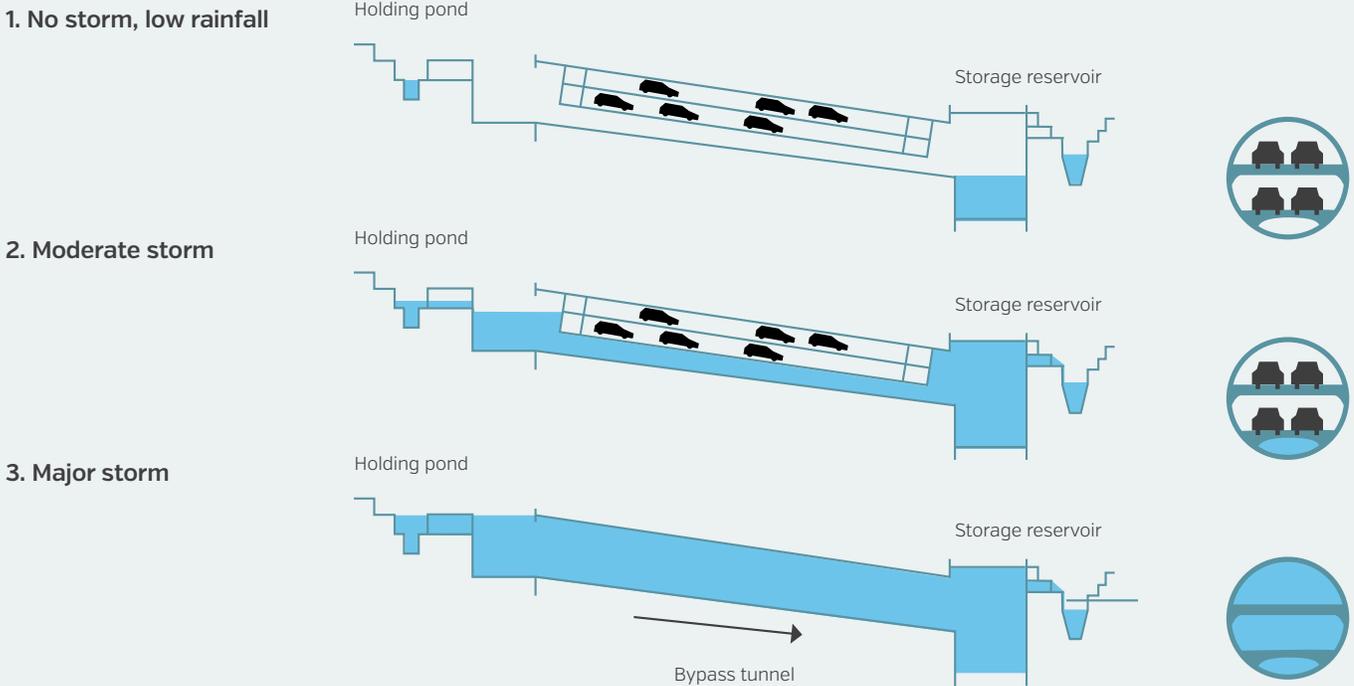
Table 4: Summary of floodgate rehabilitation activities [Source: World Bank, 2012]

	REQUIRED WORKS	ESTIMATED FINANCIAL COST [\$]	ESTIMATED ECONOMIC COST [\$]	BENEFIT AREA [HA]	ESTIMATED FLOOD PROTECTION BENEFIT [\$]	ESTIMATED FISH BENEFIT [\$]	TOTAL BENEFIT [\$]
Huay Pin	Rehabilitation of the mechanical works (gates), minor structural repairs to the headworks	72,000	68,400	120	12,375	3,600	15,975
Huay Kae	Rehabilitation of the mechanical works (gates), minor structural repairs to the headworks	52,500	49,875	100	10,313	3,600	13,913
Huay Pa Pak	Rehabilitation of the mechanical works (gates), minor structural repairs to the headworks	35,000	33,250	100	10,313	3,600	13,913
Huay Bung Or	Rehabilitation of the mechanical works (gates), resectioning of the canal (2.5 km)	31,875	30,281	150	15,469	3,600	19,069
Huay Daeng	Rehabilitation of the mechanical works (gates), resectioning of the canal (3.0 km)	38,250	36,338	170	17,531	3,600	21,131
Total			218,144	640	66,000	18,000	84,000

Source: Adapted from Environmental Resources Management and Department for International Development (ERM), 2005

Figure 5: SMART Tunnel design in Malaysia

Investing in resilience reduces losses and damages in the case of a disaster. However, it can also yield development benefits regardless of disasters. Typically, standard disaster risk management investment appraisals fail to account for the 2nd and 3rd dividends of resilience.



a park area for tourism and recreation, and the wetlands and surrounding areas are on average 10 degrees celsius cooler than non-pervious areas (such as parking zones or on the streets) at the hottest time of the day. This results in energy savings for buildings and homes using artificial cooling systems. Other wetland co-benefits include waste water treatment, maintenance of freshwater supplies, carbon sequestration, climate regulation, water regulation, soil erosion regulation, pollination, recreation and nutrient cycling. Economic analyses of selected wetland co-benefits, including flood protection, carbon sequestration, climate regulation through reduced use of air conditioning near wetland areas and waste water treatment, along with potential income from recreational activities, could be worth between \$113 to \$127 million annually (World Bank, 2015).

6.2 Transport co-benefits

DRM investments can also be linked with transport systems to combine objectives and improve efficiency. Flood embankments are often used not only to protect the landward assets from inundation but also to support road networks. In doing so, the roads themselves are also more resilient to flood impacts and can permit movement after major hazard events. These synergies can operate at a variety of scales: Levees in Bangladesh commonly support small-scale tracks for rickshaws and motorcycles, whilst the 11 dams that protect St Petersburg in Russia against storm surges are built to support 25.4 km of six-lane highway.

The Smart Tunnel scheme in Kuala Lumpur combines storm water flood drainage with vehicle tunnels under the city (see Figure 5). For Category 2 storms, which occur about ten times each year, part of the flood waters are diverted through the lower

section of the road tunnel. For Category 3 storms, which occur once or twice a year, traffic is prohibited and a large part of the flood flow is diverted through the tunnel. A flood detection system provides adequate warning time to evacuate traffic and operate tunnel floodgates as well as to minimize the cost of traffic disruption (Seang, 2009).

6.3 Agricultural co-benefits

The development of safe sea port shelters as part of the Natural Disaster Risk Management Project in Vietnam were planned to support the sustainable development of the fishing industry. The facilities are highly effective in preventing storms damages for the fishery boats, but also provide a centre for the development of fisheries logistic services. As

well as less risks to boats related to storms, fisheries business now have more adequate infrastructure, electricity, water, transportation and other logistics services for their activity (World Bank, 2014b).

The World Bank Mekong Integrated Water Resources Management Project has produced a number of economic co-benefits. Estimates of these are based on the assumption that they would be fully reached in three years and that the economic life of the investment would be 15 years. The project was designed with water resource management and flood plain management at its core and resulted in the rehabilitation of 10 floodgates in the Xebangfai River and about 40 village irrigation schemes being put in place in the Xebangfai and Xebanghieng rivers of Lao PDR.

Man scattering rice grains.
Sta. Cruz, Laguna, Philippines



Box 1: Key co-benefits of integrated DRM investments in Jamaican agriculture include:

Economic co-benefits

- DRM irrigation projects helped reduce the economic impacts of droughts, particularly in Southern Clarendon and St. Elizabeth. These farming communities have also benefited from increased productivity and output relative to other areas, even in the face of drought over the April-June quarter in 2014.

Social co-benefits

- Training and shared learning on drip irrigation has strengthened social capital and built comradeship within the communities, especially among the farmers in the field.

Environmental co-benefits

- A rainwater catchment tank and drip irrigation system in Lititz, St. Elizabeth, has improved small-scale irrigation, resulting in higher yields, less soil erosion and deforestation, and an increase in socioeconomic status for farmers.

Sources: Interviews with Ministry of Agriculture and Development Bank of Jamaica; Planning Institute of Jamaica (2007); United Nations Development Programme (UNDP) Jamaica (2012)

The floodgate rehabilitation increased flood protection (avoiding losses associated with the first dividend of resilience) for 640ha of cultivated areas, and, on average, \$13,200 of flood protection benefits per gate. In addition, co-benefits (the third dividend of resilience) included increased fish catch in the floodplain, with the average annual benefit of the increased fish catch estimated at \$3,600 per gate, not only because of reduced flooding, but also due to enhanced water regulation throughout the year (see Table 4). Increases in water use efficiency also produced co-benefits in the form of decreased electricity costs of \$2/ha (World Bank, 2012).

In Jamaica, the agricultural sector contributes about 6% of GDP and employs 17-18% of the labour force. Domestic agriculture is largely located on hillside plots, with an average size of one acre with slopes above 15 degrees; meanwhile, the export agriculture (including coffee, banana, cacao and coconut) contributes to 22% of total exports, raising \$274 million in foreign exchange each year. A number of DRM programmes have focussed on this sector, including the Jamaica Rural Economy and Ecosystems Adapted for Climate Change

(JaREEACH), which aims to strengthen local and national institutional capacity to support climate change adaptation and DRM within agriculture. The Planning Institute of Jamaica also committed \$9.9 million to the development and implementation of adaptation measures, focussing on strengthening agricultural productivity, coastal protection and building local capacity for natural resource management.

Of these investments, those that have focussed on reducing drought risk in farming seem to offer particularly high potential for co-benefits. The installation of dedicated irrigation systems to overcome the impact of drought has helped farmers to increase their productivity and output, as well as reduce soil erosion and deforestation by optimising previously inefficient farming practices (see Box 1).

7. Recommendations for decision-makers: Integrating the Triple Dividend of Resilience in DRM appraisals

Realising the triple dividend of resilience involves a strategic shift, offering a different perspective on how investments can support policies and objectives beyond DRM. The approach offers an enhanced understanding of the broader economic, social and environmental implications of investing in DRM activities. While loss data, risk models and appraisal tools are the key means for investment decision making, the overarching foundation of the triple dividend of resilience concept is a more holistic strategy that links DRM, climate and other development policy objectives. DRM is not seen as an objective in its own right – it is considered as an important lever for strategic risk management of overall development progress that reduces avoided losses and yields benefits from taking risks.

This approach starts with thinking through development strategies and the inherent dynamics of economic development. It then requires the stress testing of these strategies, based on a range of possible climate futures and the principles of avoiding locking-in development paths that are, or may become, unsustainable under climate change.

In practical terms, when making development and DRM plans, policy-makers should resist the temptation (and analytical convenience) of relying on a single set of parameters for analysing risks, costs and benefits. The characteristics of risk are often context specific and the requirements for assessment differ between local or national scales. Similarly, for hazards with a high probability of recurrence, the measurement of benefit and cost calculations may prove less problematic than for hazards with low and uncertain probabilities (such as earthquakes). We therefore suggest applying multiple approaches and not to rely on a single

assessment. By way of a conclusion, the following steps indicate some relevant guidance for decision-makers to move towards the triple dividend of resilience perspective (Garrido, 2015).

7.1 Define the problem and its context

A practical starting point for decision makers is a mapping exercise to understand development goals, threats and risk drivers.

- What are the contextual development goals set by a certain country, city, locality or village?
- What are the threats to, and drivers of, development?
- What DRM measures are proposed and how do they relate to these goals, threats and drivers?
- Who are main beneficiaries? To what extent are individuals, groups, sectors or activities better protected because of DRM?

7.2 Identify and apply tools and methods for empirical analysis of DRM

Ideally, a DRM proponent should strive to select a set of approaches that can generate quantitative measures or shed light on each of the three types of dividends of resilience. It is unlikely that a single approach can yield answers to every single benefit stream linked to DRM. A more complete evaluation requires the use of various qualitative and quantitative assessment tools. The application

of multiple approaches rather than reliance on one tool or method is recommended, especially in data constrained environments, where flexible approaches are needed.

- Conducting a probabilistic assessment rather than relying only on historic loss figures can yield clearer understanding of the first dividend (saving lives and avoiding losses).
- The biggest gap in triple dividend knowledge is in understanding how reducing background risk can help to unlock and stimulate economic activity. Using simple proxies to measure the second dividend of resilience may be necessary. Anticipated land-value increase could be used as a good estimate of increased economic activity in a given project area for example. Another more sophisticated option would be to identify risk thresholds and acceptable levels of risks for different stakeholders.
- The economic value of dual purpose infrastructure, as well as possible cost savings, can be used to measure the value of the third ‘co-benefits’ dividend. Assessments to monetise non-market values may also be required to widen the scope of assessments of social and environmental co-benefits.

7.3 Communicate outcomes

Communicating the triple dividend assessments to other stakeholders such as business, tax payers and political supporters is an essential requirement for integrating the concept into development planning:

- Communicate how DRM interventions are linked to, or can be delivered through, other development policies and interventions. Explain the benefits of DRM actions using triple dividend principles and the value of DRM interventions relative to ‘do nothing’ scenarios.

- Appropriate strategies should focus on supporting development paths that are robust to a range of possible climate and socio-economic futures. Recognising the need to integrate DRM into future development pathways, to curb the rise of disaster losses, constitutes an important step towards achieving sustainable development objectives.
- Devise strategies for communicating the dividend concept: This includes communicating how DRM interventions are linked, or can be delivered through, other development interventions; what are the benefits from DRM under triple dividend principles and are they robust under different climate and development futures?; what is the value of DRM interventions relative to ‘do nothing’ scenarios?
- Identify the implications of fear and risk-aversion. The experience of a disaster and the ever-present background risk of future disasters can hamper development and cause economic paralysis. The biggest gap in triple dividend knowledge is in understanding how mitigating such background risk can help to unlock and stimulate economic activity. While quantification of these effects is highly case-specific, one option would be to identify risk thresholds and acceptable levels of risks for different stakeholders.

Further reading

A full set of project outputs can be found at www.odi.org/tripledividend.

A set of background papers commissioned to inform this report are published as World Bank Policy Research Papers and can be accessed at <http://elibrary.worldbank.org/page/wb-working-papers>. These include:

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