UNISDR
The United Nations Office for Disaster Risk Reduction

GAR
Global Assessment Report on Disaster Risk Reduction
2013

Background Paper prepared for the Global Assessment Report on Disaster Risk Reduction 2013

Linking Investment Decisions with Disaster Risk Reduction in Water Sanitation and Hygiene (WASH): The Role of the Public and Private Sectors, Potentials for Partnership and Social Learning

Åse Johannessen
Arno Rosemarin
Åsa Gerger Swartling
Guoyi Han
Gregor Vulturius
and
Thor Axel Stenström

Stockholm Environment Institute

SEI STOCKHOLM ENVIRONMENT INSTITUTE

Geneva, Switzerland, 2013

Linking Investment Decisions with Disaster Risk Reduction in Water Sanitation and Hygiene (WASH): The Role of the Public and Private Sectors, Potentials for Partnership and Social Learning

Åse Johannessen, Arno Rosemarin, Åsa Gerger Swartling, Guoyi Han, Gregor Vulturius and Thor Axel Stenström
Stockholm Environment Institute, Kräftriket 2, 106 91 Stockholm, Sweden

Corresponding author: ase.johannessen@sei-international.org

Abstract
In the context of urban Disaster Risk Reduction (DRR) in Water Sanitation and Health (WASH) services, we examine the two very different sides of private-public interaction. On the one hand, the impact of disconnected private and public sector investments and the ensuing increased vulnerabilities and health risks, mostly impacting on poor communities. On the other hand, the potentials for novel and effective private-public partnerships (PPPs) that reduce disaster risk and build resilience. This study is a literature review using empirical evidence from case studies, from which we construct a conceptual model explaining the building of WASH vulnerability and disaster risk reduction. We identify building blocks (access, siting, mitigation/adaptation and sharing) which work over different scales. Using social learning as conceptual lens, this paper then explores the potential for potential novel and effective mechanisms to trigger and influence a collaborative process between private and public actors, which could build resilience to disasters.

Table of Contents

1. Introduction

One of the largest disaster risks on the urban horizon identified by many cities in the Resilient Cities Campaign (UNISDR) is the lack of improved Water, Sanitation and Hygiene (WASH) provision, and especially urban sanitation (UNISDR 2012). Cities, especially in low income countries with rapid urbanization are struggling to meet and address basic urban WASH (Water Sanitation and Hygiene) issues not only due to localized intensive water use, but also reduced access to infrastructure-based services, with serious economic, social, and health implications (Koppenjan & Enserink 2009). Effective financing is essential to accelerate and sustain services that could ultimately save two million lives per year (Tremolet & Rama 2012). Especially the private sector role seems to be crucial comparing its relatively low proportion in the water and sewerage sectors in developing countries, where it is on average only 35%, while in the developed world it constitutes 80% of the market (UNESCO 2006). The question we want to pursue in this paper is what characterises an appropriate cost-effective investment? In this paper we argue that these investments are intrinsically linked with disaster risk reduction (DRR) where the lack of appropriate investments can increase community vulnerability to disasters, and the right investment can build resilience.

Untreated wastewater and inadequate sanitation have major health and environmental impacts, and contributes to polluted drinking water. The health impacts include approximately 1 billion people with soil-transmitted helminths (eg Ascaris, Trichuriasis and hookworm) over 2 million deaths per year due to diarrhoea, 90% of the latter are children under 5 mostly in developing countries, 40-70 million cases of liver fluke trematodes, 200 million with Schistosomiasis, and the list goes on (Hotez et al. 2008; WHO, 2012; WHO, 2008). Diarrhoeal diseases, which are largely preventable through improved WASH, are the second worst killer in low income countries after low-respiratory diseases, measured as disability-adjusted life years (DALYS). In low income countries, more than a third of all deaths are among children under 15 years of age (WHO 2008). Second, improved WASH can be a highly cost-effective intervention. The WHO findings suggest that sanitation and hygiene promotion are among the most cost-effective interventions for controlling endemic diarrhoea (approximately US$3 per DALY averted for hygiene promotion and US$11 for sanitation promotion), ranking higher on this basis than many other health interventions, including combating malaria, tuberculosis and HIV/AIDS (Laxminarayan et al. 2006). Thirdly, over the long term, the sanitation crisis will impact on downstream ecosystems with impacts on livelihoods (fisheries, tourism) and destruction of the water resource, heavily polluted by nutrients and organic compounds (Falkenmark 2003). As water is very much a driver of economic development, the degradation of this resource already begins to trigger indirect and direct financial impacts to businesses and to the public sector with implication for long-term sustainable development and resilience (Sanctuary et al. 2006). One study showed that the annual economic growth rate was 3.7 % among poor countries with better access to improved water and sanitation services, while similarly poor countries without access had an annual growth of just 0.1% (Sachs 2001).

Public Private Partnerships (PPPs) have emerged as one way to stimulate private parties to invest their resources in public urban infrastructure projects which lack funding (Koppenjan & Enserink 2009). PPPs often aim to expand the range of service providers beyond traditional public sector monopolies and inject a measure of dynamism, increasing coverage, innovation, efficiency, cost-recovery and consumer responsiveness to previously sheltered sectors (ADB 2006). PPPs mean that the costs and benefits for development can be better shared between private and public sectors through different arrangements, involving increased cooperation between private sector, local governments, non-government organisations and local communities, in delivering services and managing resources. The public sector takes a lead role in this by defining the scope of business, specifying priorities, setting targets, and identifying performance standards against which the management of the PPP is given incentives to deliver (ADB 2006).

There is a need for strategic innovation to radically improve the modus operandi of private sector involvement. In business theory, strategic solutions (put in place by strategic innovators) means doing something genuinely different that customers like and reward, and where accepted industry assumptions about how to compete are challenged and overturned (Styles and Goddard, 2004). A strategic innovation is a "creative and significant departure from historical practice" (Govindarajan and Trimble 2005). This new way of playing the game could also involve conflicts with the existing way (Charitou and Markides 2003). Successful solutions are understood to be based on a deep understanding of customers' needs and priorities (Markides 1997). In the environmental discourse, social learning is seen as an important mechanism to foster such innovation. It is an important element of resilience, alongside self-organisation and adaptation (Folke 2006). The social learning concept has recently received growing attention also in terms of dealing with global challenges of sustainability. The Fifth Global Environment Outlook (GEO 5) Report, Chapter 17 (UNEP 2012) refers to social learning as "formal and informal processes to share knowledge and lessons, at different levels and across different communities, to support innovative problem-solving required for addressing unprecedented environmental change" (Box 17.1, p 480).

1.2 The aim of this paper

In this paper we focus on Public Private Partnerships (PPPs) as a way to address Disaster Risk Reduction (DRR) in Water, Sanitation and Hygiene (WASH). Private sector is profit-driven or at least operates on a cost recovery basis, and therefore needs to be stimulated to invest in DRR. These incentives or enabling environments need to be created by the public sector, i.e. aiming for long-term positive societal and environmental impacts.

The aim in this paper is to outline a conceptual framework including a set of key principles, which can help address the key gaps and potential mechanisms within this area. We focus on those mechanisms where social learning is needed between the stakeholders to trigger and influence action: involving a collaborative process between private and public actors to improve planning and urban development to integrate DRR.

Our main questions is: “What are the key social learning barriers and opportunities for private and public partners to boost DRR in WASH?”

2. Methodology: Framing the ontogeny of risk and resilience in WASH

2.1 Data collection

This study is based on a desktop literature review and analysis using a number of case studies (across three continents) where WASH systems are facing challenges exacerbated by hydro-meteorological disaster events.

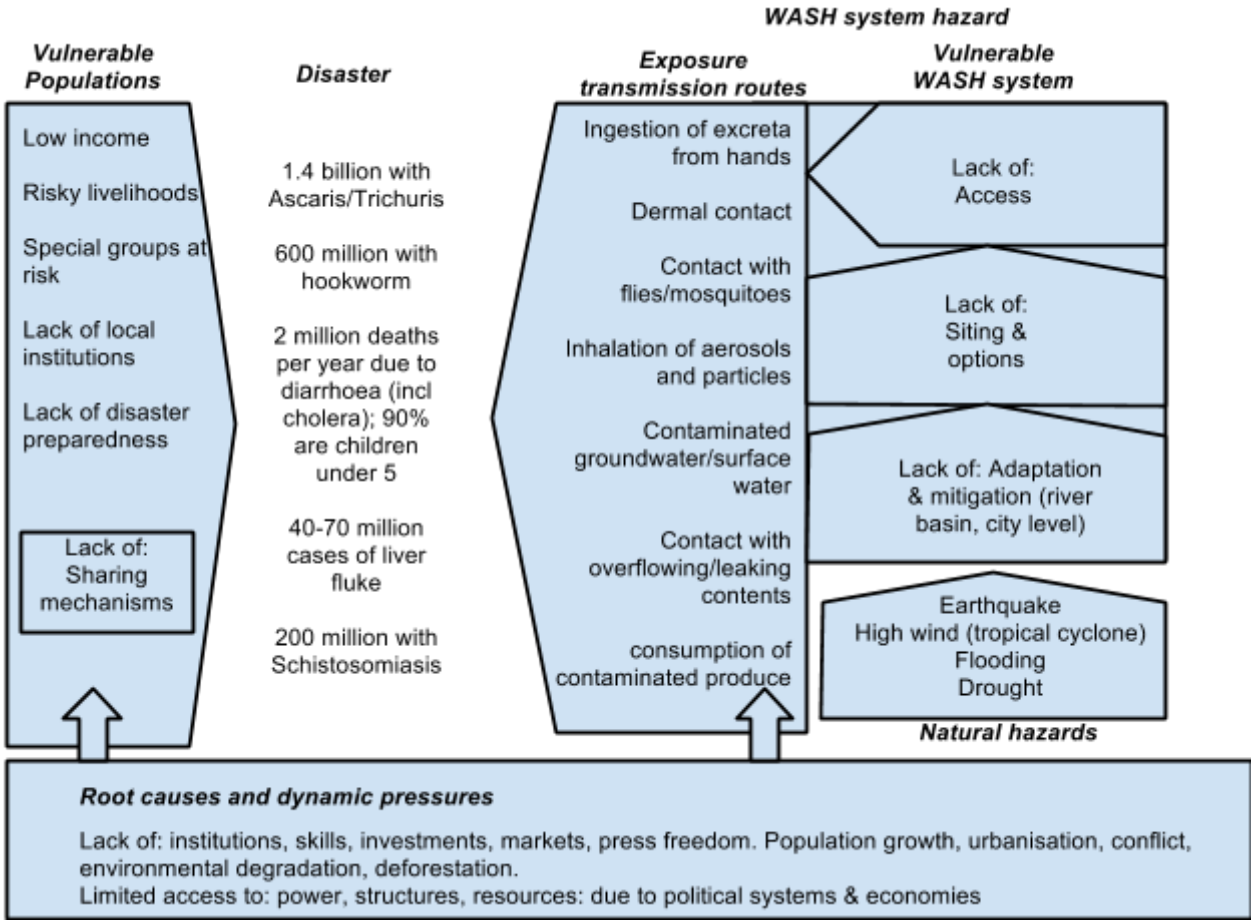
2.2 Framework of analysis

The framework is aimed at defining the ontogeny of risk by putting the WASH system terminology into perspectives of DRR, vulnerability and resilience (including social learning). We describe the main challenges and gaps focusing on a few building blocks in this framework (which we label access, siting, mitigation/adaptation, sharing), for private sector participation. We then identify how resilience can be built in these areas, especially focusing on solutions where social learning can potentially bring about collective action to enable private sector participation for improved WASH services.

2.2.2 Natural hazards and exposure

Human faeces is the most dangerous to health of all human excreta, and constitutes “a dangerous substance or human condition that may cause loss of life or other health impacts, loss of livelihoods and services, social and economic disruption, or environmental damage” - i.e. the definition of a hazard (adapted UNISDR terminology). We refer to this as a WASH system hazard (see Fig 1). One gram of fresh faeces from an infected person can contain around 100 viral pathogens, 100 bacterial pathogens, 100 protozoan cysts or oocysts, and 10–100 helminth eggs. These can reach a human via faeco-oral disease transmission pathways (fluids, fields, food, flies, fingers).

This hazard can originate from a series of vulnerabilities in the WASH system, even up to the river basin level. Vulnerability (or sensitivity) describes the tendency of a receptor to experience harm (Klijn et al 2004; Brooks 2003; Adger 1999) to a specified hazard or range of hazards (Brooks 2003). In our framework we separate the vulnerability of a WASH system and the vulnerability of the communities affected (Brooks 2003). Defining a disaster in this way takes into account - not just the number of people reported killed in disasters over the ten-year period 2000−2009 which is 1,105,352 but also the number of people killed by diarrhoea just in one year, i.e. 2 million. (Table 2, Annex 1, Red Cross World Disaster Report 2010),



*) Hazards are influenced by a degraded environment, and also by inadequate WASH systems. For example, an overuse of the water resource (surface water, groundwater) can result in drought, and inappropriate planning and siting of WASH infrastructure can result in channeling and consequently flooding.

Figure 1 Factors that lead to disaster in WASH systems (adapted from the PAR model, 'pressure and release' by Blaikie et al 1994).

Access

It is only those who are exposed by a hazard who can be affected by it (Gouldby and Samuels 2004). Access to WASH, i.e. hand washing, improved sanitation and safe water can be an effective barrier to exposure to health hazards (Mara et al 2010). Access is the first baseline building block to reduce the WASH system hazard, where improved facilities (for example, toilets and latrines which allow people to dispose of their waste appropriately), help break the exposure and infection cycle of many diseases. Not only infrastructure is important but also hygiene, which refers to acts that can lead to good health and cleanliness, such as frequent hand washing, face washing, and bathing with soap and clean water. Practicing personal hygiene in many parts of the world can be difficult due to lack of clean water and soap (CDC webpage). A vulnerable WASH system can in itself cause disasters in terms of disease outbreaks. Lack of access does not mean that there are no WASH systems in place, but that existing systems have become dysfunctional, due to lack of operation and maintenance, or old age, due to several underlying root causes. Lack of access can also be caused by the providers' inability to answer to the community motivations, real needs and

preferences, and be sensitive to gender aspects, disability and for children. The systems can also (biophysically) be vulnerable if functionality is restricted to only a few hours per day. This also means that as water pressure normally keeps the pipes clean, when water pipes are empty, contaminants can enter, through leaks. Dysfunctional systems are also costly for the poor who have to rely on private water vendors delivering water from small (broken) pipe systems, jerrycans or tankers, usually also at a unit cost several times that delivered via public water supply systems to the middle and upper classes (Bakker 2003).

Siting & options

Exposure can also increase when facilities are sited in low lying floodplains exposed to floods which can cause inappropriate sanitation options to leak and contaminate potable water sources (Pantelic and Srdanovic 2007). This is the case in many cities, and especially the low income areas. A flood exposure analysis in Kigali disclosed that 27% of buildings were located in flood prone areas involving vulnerable infrastructure, buildings, population and economic activities (Bizimana and Schilling 2010). Rural-urban migration and city expansion via informal settlements on peri-urban boundaries can mean increasing exposure for such city dwellers. This is not only due to infrastructure and service demands reducing access, but due to unplanned environments with increasing crowding (conventional options not possible) and lack of adequate operation and maintenance rendering facilities dysfunctional (Guarin et al. 2004). In a city there is a clear segregation between the rich and poor neighbourhoods, and exposed communities are mixed in with more high income areas (Pantelic and Srdanovic 2007; Thompson 2004). In spite of the various risks, human settlements continue to develop in flood-prone areas (Gupta 1994).

In cities with unplanned environments, lack of appropriate water and sanitation options is a great problem. For example Maputo city centre is served by a conventional sewerage system that in 2000 only covered 24% of the population, and 36% of residents used low-cost improved latrines, 28.3% unimproved latrines, and 15.2% septic tanks. Without drainage and with inappropriate siting of waste or sanitation facilities, these easily contaminate downstream areas, especially in floodplains or coastal areas (Stephenson 2002). For example, in approximately 12 neighbourhoods of Maputo people live in areas with a high water table that is prone to annual flooding during the rainy season. In these neighbourhoods the risk of poor on-site sanitation resulting in cholera is a significant concern for the authorities (Thompson 2004). The lack of options and planning makes siting an often forgotten problem, when the biggest focus often is on access.

Adaptation & Mitigation

A long tradition of land use changes including control and command approaches in water management through structural measures such as levees and embankments has not only protected against severe floods but also triggered them. What looks like a good idea to shut out flood variability (disturbance) can build vulnerability over time when developments continue behind structures without flood-robust adaptations. However, a different approach is emerging in many countries whereby humans must provide space for floods and when they occur they need to be managed better. Such is the case in the Netherlands ‘Room for the River’ programme (Silva et al 2004). Buffer capacity in the river basin such as wetlands and meandering water courses, can reduce flash flooding in downstream cities. Natural processes such as sedimentation in deltas are important functions to maintain shorelines, to

such extent that large-scale engineering projects are much more a threat to the long-term sustainability of populated deltas than is sea-level rise associated with global warming and the global ocean volume increase (Syvitski 2008). Also within cities, green buffer zones play a role. Ecosystem services within the city often are put on the back burner in rapid urban development. With the encroaching of urban waterways i.e floodplains, mangrove estuaries, urban green zones, public parks, etc., the reduction of infiltration, increase of runoff and removal of flood buffer capacity, through solid surfaces may exacerbate urban flash flooding and erosion which can clog drainage canals (Baker 2012; Matagi 2002). Not addressing adaptation and mitigation in the watershed can undo many investments in WASH systems downstream, in the same way as badly sited/exposed systems need risk reducing measures or be relocated so as not to be washed away in the next heavy rainfall. This building block in WASH vulnerability is difficult to address as it requires rethinking of old paradigms, and introducing prevention in areas with high pressure for development, attractive land and strong economic interests.

2.2.2 Vulnerable populations, root causes and dynamic pressures

Looking at social vulnerability, this is a complex characteristic of individuals and groups of people within a given area, produced by a combination of factors, derived especially (but not entirely) on class, gender, ethnicity, wealth, education, disability, health status, age, and other social and cultural characteristics (IPCC 2012). For example age may be important: older people may be recovering from illness or injury, less able to escape hazards, and elderly from poorer classes or other ethnic groups may be more vulnerable than others (Cannon 1994) To understand the dynamics and root causes of problems it is important to understand these peoples world view, motivations and drivers. An important priority for these dwellers is economic opportunity, as urban slums are often inhabited by migrants who seek employment (Satterthwaite et al 2007) and do not have ownership of these temporary dwellings, which provides no incentives to reduce the WASH systems hazard. Since the vulnerability of WASH systems is high in slum areas, the impact on the local population is high, even with a smaller rainfall event like the annual rainy season. The consequences are even greater because this impacts on the poorest and most vulnerable individuals and communities.

Sharing

Sharing mechanisms include a wide variety of redistribution of wealth. Insurance companies are arguably the most resourceful actors in the private sector for enabling this sort of sharing. The core business of insurances includes assessment, quantification, mitigation and transfer of risk and damage potentials. Insurability of damages from disasters is achieved by pooling risks across time, large geographical areas and large numbers of policyholders (Maynard 2008). But there are also directly supporting instruments, e.g. social funds and livelihoods programmes, which can enable communities to make investments which are vital for building resilience and make a transition into new livelihoods, often in new sectors and in urban areas where they may need temporary support.

Box 1:

Risk = Probability of a Hazard x Consequences
(Helm 1996)

Consequence (or Impact) = Exposure x Vulnerability
(Klijn 2004)

Vulnerability = Sensitivity x Value
(quantity e.g. 1,2,3, etc or category e.g. high medium low)

2.2.3 Social learning as a way to build resilience

Over time, humans learn how to collectively respond to problems encountered, sometimes over the short term (coping) or over the long term (adaptive strategies). Coping mechanisms are the bundle of short-term responses to situations that threaten livelihood systems, and often take the form of emergency responses in abnormal seasons or years. Adaptive strategies, on the other hand, are the ways in which individuals, households and communities change their productive activities and modify local institutions to secure livelihoods for the long-term (Berkes and Jolly 2001). Social learning can build resilience over time through "a change in understanding that goes beyond the individual to become situated within wider social units or communities of practice through social interactions between actors within social networks" (Reed et al 2010) involving many stakeholders from different organisations (Schusler et al 2003). See Fig 2 below. Social learning has been explored in WASH governance in general and proven its effectiveness with many lessons learnt (Butterworth and Morris 2007; Van Koppen et al. 2009; Moriarty et al. 2007; Schusler et al. 2003; Pinkerton 1989; Pahl Wostl et al 2005; Tippett et al. 2005; Mostert et al. 2007; Blackmore et al. 2007). Characteristics of social learning include some degree of reframing, often through an explorative process where the frames of reference are altered to better understand and relate to reality or adapt to change. As such a social learning process can bring about so-called strategic innovation, which is a term more used in business theory. The strength of strategic innovation lies in its potential to produce dramatic value improvements for customers (Schlegelmilch et al. 2003). In this case it would be the beneficiaries of WASH service provision (Berghman 2006). Applying strategic innovation thinking to the area of water and sanitation, understanding and working with community user preferences is crucial and the value of and how to use each option need to be understood. For example, after the great Tsunami of South Asia in 2004, many houses were built without toilets and as many as 250,000 houses had to be retrofitted. This shows the role of finding ways to make people aware of the importance of sanitation.

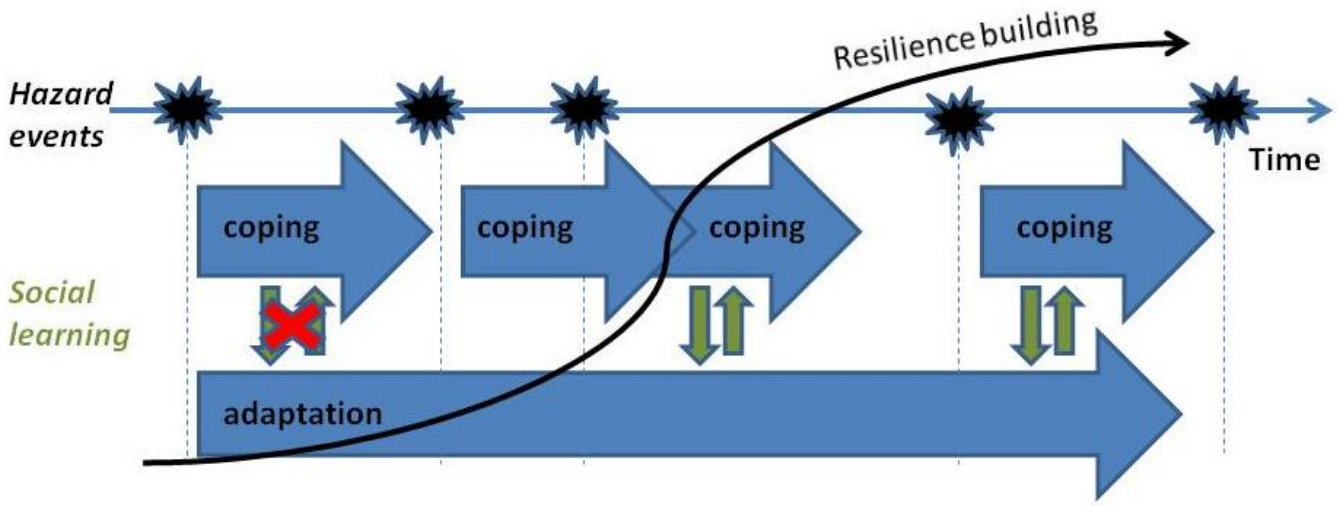


Figure 2. Social learning consists of short term episodes of coping which lead to long-term periods of adaptation. The net effect is experience and resilience building within the community.

3. Linking investment decisions with disaster risk reduction in Water Sanitation and Hygiene (WASH) - What is missing?

Here we will look more closely at the above building blocks of the framework to see what is missing in terms of investments and why this may be the case.

3.1 ACCESS: Lack of trust among actors who need to collaborate

"There is no doubt that delivering sufficient safe water and adequate sanitation to the growing urban populations of Africa and Asia remains one of the biggest challenges of this century" (Mara & Evans 2011).

Most cities in Africa and many in Asia with a million or more inhabitants have a large gap in basic level WASH provision, most notably sewerage infrastructure. Progress in establishing more sewerage infrastructure is expected to continue to 2030, but it is still projected that there will be 1.1 billion more people worldwide in 2030 who lack access to basic sanitation services compared with 2000 (OECD 2011; Jouravlev 2004 in OECD 2012). Rivers, streams, canals, gullies and ditches are where most human excrement and waste water ends up, untreated; in essence open defecation. For those cities with sewers, rarely do they serve more than a small proportion of the population - typically the richer residential, government and commercial areas (Hardoy and Satterthwaite 1991).

There is a dire need for investment in water and sanitation systems, and in order for them to provide increased access, quality and efficiency, it has been suggested that private

participation needs to increase (Marin et al 2009) with different mechanisms for implementation and monitoring (Tremolet and Rama 2012). However, empirical evidence of the impact of private sector participation in the sector is mixed (Clarke et al 2004; Kirkpatrick et al 2004) and some even conclude that promoting private sector participation – at least as it has been pursued to date – is not going to help ensure that the water and sanitation targets are met, and may detract attention from the more important changes that are needed (Budds and McGranahan 2003).

It is important to note that the opportunities and challenges for private participation look very different especially in terms of the types of players involved, and whether we are talking about water supply or sanitation. Water supply is in many places much more straightforward than urban sanitation.

Experience suggests that the lowest-income groups, with the least access to water and sanitation services, receive the fewest benefits from private provision (ibid). This can have several reasons. Private sector is risk-averse making it easier to focus investment opportunities with the wealthy, and not being attracted by poor urban community service provision since it means operating on narrow margins with poor clients. Businesses are also often ill-prepared to service the low-income market, and their lack of experience with poor clients makes them even more wary of exploring profit-making opportunities in the slums (Baker 2009). The lack of experience furthermore creates misconceptions which do not encourage business to engage. Many are unaware that the urban poor are both able and willing to pay for water services and generally do not recognize the potential economic and political benefits of serving the urban poor. For example, poor people living in the slums often pay 5-10 times more per litre of water than wealthy people living in the same city (UNDP 2006). But also, regulation may not provide for an enabling environment for neither publicly or privately operated utilities to serve the majority of low-income households (Budds and McGranahan 2003). The urban poor, meanwhile, often lack the social, organizational or political skills needed to approach providers or government officials to negotiate access to the services that are so vital to their social and economic well-being. Limited awareness and information on both sides contribute to mistrust and a lack of mutual solutions between providers and their poor constituents (USAID 2006).

Its important to realize that there is already existing informal WASH service delivery in slum areas. Small-scale independent providers (SSIPs) or non-state provision (NSP) have often since long provided water supply, not of great quality, and at a high price, but nevertheless providing access. However, these players lack the benefits of economies of scale, investment capital, long run corporate accountability, and integration of the slums into the greater city that are normally pursued with private sector partnerships (Baker 2009). Government approaches have unfortunately often been trying to replace those informal players rather than assist them (McGranahan et al 2006). To the larger private company operating in the other areas of a city they represent a competitor, albeit operating in areas where they have not yet developed coverage. Increasingly, however, formalizing service provision by small-scale independent providers (SSIPs) is practiced in partnership with formal utilities as an alternative model but little is known about how these partnerships actually function and the potential of such partnerships as an alternative model for service provision in peri-urban areas (Schwartz and Sanga 2010).

Urban areas furthermore provide challenges in that they may not provide socially cohesive structures to work with, may not be able to provide adequate funding for communal infrastructure and may not be able to provide in-kind labour contributions due to other work commitments - conditions that are often assumed in rural communities. Urban WASH therefore requires greater effort and time for community decision-making and specification of boundaries for project coverage (Willets et al 2008). A major problem is also the lack of tenure, where even slum owners are not even the informal owners of their dwellings. For example, mobilising bank loans for toilet construction in a house of which you are not the owner is therefore difficult and is an investment which can easily be lost.

Apart from (informal) private entrepreneurs, CBOs and NGOs can also act as service providers, although they are more active in rural areas (Willetts et al 2008). For example, SPARC is one of many Indian NGOs that has supported community-designed, built and managed toilet blocks serving hundreds of thousands of poor urban dwellers. Their experience also highlights the importance of working closely with communities and supporting their incremental organization - including the power of women's groups (Burra et al 2003). NGOs have taken a lead in piloting and promoting new technologies and approaches such as the hydraulic ram water pump (e.g. World Vision), composting toilets, the PHAST and SARAR methodologies and most recently, Community Led Total Sanitation (CLTS) (e.g. WaterAid, Plan and Oxfam). NGOs tend to provide training across the sector, inviting one another to participate and learn about new approaches (Willetts et al 2008).

While policy is now generally in support of Non State Provision (NSP), practice is more often unsupportive and relationships are surrounded by mistrust. The main providers of non-state services—local entrepreneurs, individual practitioners, community organisations and small NGOs—are largely absent from any dialogue with government or city authorities (Mara and Evans 2011). They are also exposed to forms of regulation that are largely repressive and effectively designed to protect established interests (Batley 2006). At the same time, government led processes are also perceived being very politicised as persons are replaced after a mandated period, which leads to reduced motivation from other actors, for example an NGO, to engage in a cooperation (Erik Rottier personal communication). Local governments can also be reluctant to get involved (Burra et al 2003). Hesitancy can also come from within the community, due to reluctance to trust the efforts of government, politicians and NGOs, a result of past disappointments (UN 2006).

In conclusion, private sector could play a more important role in DRR interventions concerning WASH, but the levels of the playing field are not equal and misconceptions, poor communication, dialogue and lack of trust, act as powerful barriers to learning between stakeholders. This is a serious impediment to long-term social learning about sustainable WASH delivery and build up of long-term institutional capacity.

3.2 SITING & OPTIONS: Knowledge of what fits the local environment is missing

Efforts to increase access to improved sanitation, are all well and good, but they often do not take adequate consideration of risk reduction for public health. Household sanitation options are often implemented, but raw wastewater discharge into open stormwater drains (if there are any) is a common feature in many poor urban areas globally which many times defies the purpose of the household efforts. Children often play in the streets and become exposed. For example, in India, a major program was launched to provide low-cost on-site sanitation in semi-urban areas. Most of the households received pour-flush latrines that discharged into single or two-chambered septic tanks. The only option considered was conventional sewerage, which was deemed too expensive. Although the new arrangement has eliminated manual scavenging practices and resulted in odor-free and fly/mosquito-free toilets, its effectiveness in achieving public health and environmental benefits is questionable. First, the partially treated and pathogen loaded overflow from septic tanks is being drained to the curb-side open channels, which were earlier carrying only greywater. Pathogen load was also increased by a small section of households that directly flush their toilet wastes into the street drains. Secondly, these drains overflow very easily from silting, dumping of garbage, or during heavy rainfall during storms. Thirdly, the high density of not-so-watertight septic tanks allows pollutants and pathogens to leach away from the site, causing groundwater contamination. Turning away from conventional sewerage options has led to the adoption of ad-hoc and inappropriate on-site sanitation measures and the resultant adverse public health and environmental conditions (Sundaravadivel et al 1999).

The example above mentions storms as a trigger for contamination. Building water and sanitation infrastructure without integrating disaster risk reducing elements is retrogressive (Erik Rottier personal communication). There are many such challenging environments for sanitation which require special solutions. It can be a permanent feature or associated with an extreme event and include for example:

- flood affected areas; where the water-table is very high and where groundwater sources are likely to be contaminated
- where there is hard rock close to the surface, making excavation very difficult
- where the ground is so soft that pit walls collapse before an adequate depth can be reached
- in crowded peri-urban or urban environments where there is little available space and limited accessibility
- where it is not allowed to dig, or insecure land tenure makes it difficult to assign locations for waste facilities and disposal

(adapted after Harvey 2007).

Too little attention is paid to adaptations of sanitation options to make them better suited for likely challenging environments, and really provide effective health benefits, instead only a very simplified menu of options is promoted. Conventional sewerage is not an option when the capital costs and water requirements are too high for the area in question, with continuing significant costs for operation and maintenance, lack of financial and technical strength within the local administration, and too narrow streets and unplanned settlements. When conventional sewerage is ruled out for poor urban areas, pour flush / pit latrine, with a septic tank seems to be the only options which remains (Sundaravadivel et al 1999). However these options are not either any good in flood prone settings: Pit latrines often found in the poorer neighbourhoods are often located in low lying flood plains with high groundwater tables causing contamination and leakage. Septic tanks generally cause

problems in low lying waterlogged areas, due to the high water table. (Hardoy and Satterthwaite 1991). Septic tank effluent cannot flow away and may flood compounds making them messy and muddy (Harvey 2007).

Unfortunately in many cities, there is a lack of awareness and knowledge and willingness for experimentation with other options which are low cost and tailored to the crowded urban environment. In general there is a need to increase investments for capacity building in the water and sanitation sector in developing countries (Zeug 2011). One barrier is that WASH practitioners and urban planners represent two different communities of practice, which do not interact with each other. An example of this are the technical committees for Environmental Impact Assessments (EIAs), an important quality control mechanism to ensure the right option gets into the right place. It is required by regulations in many countries, for example to get a permit for WASH infrastructure (Tyskeng 2006). However, these committees may not have the relevant competence to evaluate (suitable) sanitation options. The follow up after an EIA to control compliance can also be a gap where profit is made at the end of the housing construction process (Johannessen notes from focus group discussions with CLASS-A in Mozambique). In general, EIAs can be improved in many ways. It is not an absolute measure, but more of a normative process, where the quality of the EIA very much is up to the person carrying out the assessment and the commissioning body (often local government) often requiring approval by a technical committee. There are many reports of serious issues in the implementation of EIAs, due to e.g. defective environmental legislation, weak enforcement, lack of expertise and budget, understaffing, weak coordination, low business support, and exclusion of the public (Kakonge 2006; El-Fadl and El-Fadel 2004; Boyle 1998).

Unfortunately much of efforts in promoting sanitation is one size fits all where often only one single technology is promoted with subsidies attached to it instead of promoting multiple options where some are more fit to cope with challenging environments e.g. flooding or water scarcity. Take the example of school latrines designed with flush toilets where no water source is available (Ockelford, 2006 in Willets et al 2008).

3.3 MITIGATION (of risk) and ADAPTATION: Building without consideration to water flows and ecosystem services

As part of long-term sustainability, climate adaptation and resilience, cities can implement a range of strategies, plans and infrastructure upgrades to increase efficiency, improve water and wastewater treatment quality, and increase resilience to climate change impacts - tackling water leakage by upgrading pipes and adding water conservation and reuse technologies through financial incentives for recycled water systems and low-flow appliances (OECD 2011); C40 & ARUP 2011 in OECD 2012). However, these hard won and costly investments may be jeopardised in one blow by inadequate attention to risk management at larger scales up to the river basin level.

Structural mitigation and adaptation have been favoured by many countries for flood control in combination with relief efforts (Neto 2001; Few et al 2004) rather than integrated social and technical programmes that incorporate flood preparedness and non-structural mitigation.

Improving safety and protection against floods, storms and sea surge through sea walls, embankments, or levees for flood protection is sometimes necessary. However, these solutions are capital intensive for their building, operation and maintenance, and in the process can be prone to corruption. Embankments also do not offer full protection against floods and they often create a false sense of security in that populations at risk tend to take less precautionary measures to adjust to floods (Neto 2001). The Hurricane Katrina hitting New Orleans in 2005 and the tsunami hitting Fukushima, Japan in 2011 are both examples where embankments and levees in fact made the populations behind them even more vulnerable to the consequences of a breach.

New Orleans had a 350-mile protective ring of levees, flood walls, gates, and pumps (Schwartz, 2010). During the hurricane in 2005 and subsequent storm surges, the levees were breached in 50 different places (Bea 2006). There were many unfinished sections, outdated structures, and lack of coordination both in design and maintenance, due to lack of funding. Much of the water supply system of the Greater New Orleans Area was wiped out after the storm. In the entire area affected by the hurricane, over 1,200 water systems and 200 wastewater systems had been affected. Estimates by Louisiana public officials declared that 50% of existing treatment plants and 20% of sewage collection systems needed rebuilding (Copeland 2005). In New Orleans, after Katrina had struck, waterborne infectious diseases were not only a concern due to the physical destruction of the water and sanitation system infrastructure, but also due to the massive amounts of floodwater in the city that was directly caused by the failure of the hurricane protection system and the levees (Seed et al 2006). The ill-preparedness of New Orleans is not an isolated case in the world and it is not even an isolated case in the United States. In the interview with the experts on levee design and maintenance, they cite many dam and levee projects across the US that remain unfinished (Malam 2010).

Structural mitigation and adaptation can also come at the cost of ‘green infrastructure’ such as wetlands protecting the coast from land loss. One illustration of this is the smaller impact that Hurricane Betsy in 1965 had compared to Katrina - both hitting New Orleans. This is very much connected with the ‘flood taming’ ecosystem services of wetlands, which were still there in 1965 but had disappeared with the land loss between 1965 and 2005 bringing the shoreline about 20 miles closer to the city. Much of the wetland losses were ironically due to the levees and the dam barriers which were built to protect the city from hurricanes. This is how human made structures reduced the wetlands outside New Orleans:

1. Levees and dams constrict Mississippi River movements so that sediments are not carried to the delta and wetland and consequently the shoreline retreats inland
2. Channels for shipping transport and associated dredging accelerate land loss
3. Man-made construction interferes with natural sand migration and dune restoration causing beach retreat
4. Dredging for canals, pipelines, etc. rapidly convert wetland to open water

Also green infrastructure does not easily attract support. After Hurricane Katrina even more structures in terms of levees and were recommended (Klein et al 2007).

Another ecosystem-related underlying cause to flooding is deforestation, which contributed greatly to one of the worst floods in China’s modern history in the Yangtze River in 1998

where 220 million people - one fifth of China's population at the time were affected, and that at least 15 million were rendered homeless (UN 1999). In Bangladesh, flood intensity has increased with all major floods covering more than 30% of the country (total area of Bangladesh is 144,000 km) since 1974. A rapid increase in population in the Indian subcontinent over the course of the 20th century has resulted in an acceleration of deforestation in the hills of Nepal to meet the increasing demands for food and fuel wood (Sharma 1991). Deforestation of steep slopes is assumed to lead to accelerated soil erosion and landslides during monsoon precipitation, which in turn is believed to contribute to devastating floods in the downstream regions such as in Bangladesh. Deforestation within Bangladesh also contributes to the soil erosion. The amount of forest cover in Bangladesh was reduced from 15.6% in 1973 to 14.6% in 1985-86, and eventually to 13.4% by 1987 (RFT 1991). A minimum of 25% forest cover is suggested for a healthy ecosystem. The amount of forest cover in Bangladesh at the present time is believed to be less than 10%. This impacts on the affected city's WASH systems. In the flood of 1998 in Bangladesh Greater Dhaka's 11 million inhabitants were seriously affected and the city's drinking water, sewage and drainage systems were disrupted and seriously impaired. As a result, disease caused by polluted water and contaminated food, such as diarrhoea and hepatitis, spread rapidly through many poor areas of the capital (Neto 2001).

Urban appropriation of green spaces ignoring hydrological processes may impact WASH systems and contributes to dysfunctional systems and contamination. For example, in the cities of Bangladesh (Rashid 2000) besides natural causes, unplanned infrastructural development, and inadequate and inefficient drainage are the main causes of floods. Diminishing water bodies and interrupting river flows are also conducive factors that worsen situations. For example canals in Dhaka City are now filled up supporting settlements and businesses. The Dhaka City Protection Embankment that was built at great expense is not properly maintained by the authority. A lot of urban poor have built houses and shops on the embankment, gradually damaging its strengths and capacity (Rana 2011).

At the same time as society is being affected by disasters due to fundamental flaws in planning and stakeholder collective action, private companies are mostly interested in response activities. For example, Hurricane Katrina provided a wake up call for many businesses, not the least as they realised how vulnerable their own investments are to natural hazards. For example Katrina struck where Shell Oil has a major office location with nearby manufacturing facilities. A month later, another major storm, Hurricane Rita, struck the Texas Gulf Coast, impacting a key petrochemical center in Southeast Texas (Wilson 2012). Much of the support focuses on emergency response by large companies and support to communities (Cooper 2012). There should be plenty of incentives for businesses to work with preventive and risk-reducing measures. In 2011 Bangkok experienced a serious flood resulting in approximately 13.6 million people affected and 1,425 billion baht (US$ 45.7 billion) in economic damages and losses due to as of December 1, 2011 (World Bank estimates). Most of these economic damages were linked to manufacturing industry, since several major industrial estates were inundated by as high as 3 meters during this flood. This made it the world's fourth costliest disaster as of 2011, only less than 2011 earthquake and tsunami in Japan, the 1995 Kobe earthquake, and Hurricane Katrina in 2005. Smith Dharmasaroja, head of the Natural Disaster Warning Foundation in Thailand claims that more water should have been released from the Bhumibol and Sirikit Dams also used for irrigation and electricity production. However, this is a simplification, not addressing the

underlying causes or slow processes which are at work. Over the last few decades, industrialization and the accompanying processes of urbanization have led to very different land-use patterns, (roads, housing estates and other concrete surfaces have been authorised and built with virtually no thought about their implications in impeding proper drainage, deforestation and removal of wetlands), economic structure and livelihood base. Today, even relatively modest river flows could result in damaging floods, so structural measures to control floodwaters have proliferated. Unfortunately, these have often created new problems – by shifting the flood risks somewhere else or by creating incentives for further floodplain development in high risk areas protected by modest dykes and diversions (Lebel et al. 2005).

The appreciation of green zones and ecosystem services is one thing, but avoiding their development and their preservation and maintenance is another. It is important to realise that local decision makers and planners do take a city-wide development focus, but protecting green zones and upgrading of slum areas are often not on the priority list. First priority is mainly to attract investment and economic activity to the city. This is unfortunately done by turning a blind eye to developments which are unsustainable, bringing in short-term business investments. Often the areas where an investment is needed to protect the environment or cleaning up the waste are put on the back burner and ignored to generate some extra profit. To support this unsustainable behaviour, there is often a lack of control mechanisms or enforcement.

Another motivation is also corruption and infrastructure projects are known to be especially susceptible to corruption. Corruption lowers the effectiveness in public investments, by influencing the decision making process connected with public investments and consequently deters private investors from contributing (Everhart & Sumlinski 2001). Corruption thrives in capital projects where ribbon cutting politicians can be seen as promoting growth in terms of schools, hospitals, dams, irrigation canals, roads, power plants, water treatment plants, ports and airports. At the same time, such investment projects are often carried out with a foreign private partner, who is likely to pay a ‘commission’ for being awarded the contract. The result is that the capital investments are favored projects but in relative terms they turn out to be expensive to the communities who in the end pay for them (Tanzi and Davoodi 1997). For example in India, politicians oppose community-managed processes, as they do not like working with groups which they find difficult to approach for bribes. Community management also goes against the long and dishonourable tradition of contractors, engineers and councillors getting a cut from each project, often through inflated cost estimates (Burra et al. 2003). In Bihar, India, private actors are even reluctant to establish themselves because they know the challenges of lack of transparency in the area, especially in connection to permits (Kumar personal communication). Corruption tends to be reduced by the separation of powers; checks and balances; transparency; a good system of justice; and clearly defined roles, responsibilities, rules, and limits. Corruption tends not to thrive where there is a democratic culture, competition, and good systems of control, and where people (employees, clients, overseers) have rights to information and rights of redress. Corruption loves multiple and complex regulations with ample and uncheckable official discretion. Bribery also undoes what diligent efforts of monitoring and enforcement is trying hard to improve. Most of these ideas apply to businesses as well as to governments. For example, private companies also do not tender in a transparent process, for service contracts. So does a metaphorical formula is useful: **C = M + D – A** “**C**orruption equals

Monopoly power plus **D**iscretion by officials minus **A**ccountability" also known as the Klitgaard formula (de Asís et al 2009).

In conclusion, there are major gaps in the over emphasis on structural flood barriers on the one hand and the unsustainable management of affected ecosystem services on the other. Corruption is one driver for preference for structural investments. However, the motivating driver to invest and maintain these from a business perspective point of view is tricky. Transparency and capacity building for green DRR projects need to be further promoted (www.pedrr.net).

3.4 SHARING: A rapidly developing field - also targeting the most vulnerable?

In high-income countries, governments are typically financially equipped with reserves and quick budget reallocations to cover their legal and social post-disaster responsibilities. Private insurers also take a large proportion of the burden. In developing countries on the other hand, the role of private insurers is non-existent, and governments often rely on humanitarian assistance and financial aid to respond to disasters. Furthermore, weak non-life insurance penetration in most developing countries, particularly low-income countries, means that private insurers shoulder little to none of the losses (World Bank 2011). A healthy domestic insurance market can be a conduit into the international reinsurance market, allowing countries to tap into a pool of over US$400 billion of capital to aid recovery in the aftermath of a disaster. One explanation why Chile proved to be resilient in face of the February 2010 earthquake, was that domestic carriers passed on 95 percent of the insured losses to the international reinsurance market. The fraction of insured losses coming from the reinsurance market over the last ten years is around 35 percent (World Bank 2011).

For Haiti, reinsurance broker Holborn Corp. has estimated economic damage to property values due to the earthquake of 2010 to be over US$10 billion. Because of the country's low income rates and limited insurance penetration, insured losses are expected to be a fraction of economic losses, one estimation amounts to less than $20 million annually. The Haitian government received an $8 million payment from the Caribbean Catastrophe Risk Insurance Facility (CCRIF) as a result of insured losses from the earthquake. The funds will serve as a revenue stream for the government to continue operating after the earthquake. CCRIF is a risk-pooling facility owned, operated, and registered by 16 Caribbean governments in partnership with the World Bank and established to provide economic stability for the catastrophe-prone region. CCRIF allows Caribbean countries to pool catastrophic risks, reduces the cost of insurance, and provides Caribbean governments with short-term liquidity when the policy is triggered after a major hurricane or earthquake. The recent earthquake was of sufficient magnitude to trigger the full policy limit for the earthquake coverage, effecting payment after a 14-day waiting period (King 2010).

Insurance markets indirectly influence total economic exposure (insured and uninsured). A functioning domestic insurance market can encourage risk-averse behavior in a population, as information about risk is embedded in prices. Where higher premiums indicate higher risk, insureds have a strong incentive to invest in risk mitigation or to avoid investing in assets

located in zones vulnerable to natural hazards (World Bank 2011). However, insurance can also create perverse incentives. In USA, property owners take taxpayers dollars through a package of subsidies for flood protection structures, federal flood insurance, and after-the-fact disaster relief. This enables and even encourages settling in low-lying flood risk areas. If they are not allowed to do this, they can claim compensation under the fifth amendment (Klein et al 2007).

Partnerships of insurances and governmental actors have led to the establishment of disaster risk insurance schemes that link risk transfer and risk reduction (Surminksi and Oramas-Dorta 2011). Experience from these partnerships suggests that doubts about commercial viability on the one hand and mistrust in private sector's profit making remain challenges for private-public partnerships (Keskitalo et al. in press). The poorest of the poor are however often not able to invest in disaster preparedness strategies (Zeug 2011). An insurance targeting poor people would need to work around lack of official identities and tenure rights, with pro-poor business models and be effective in non-traditional markets. This has many challenges, for example, under the 'Sanitation as a Business Program' in Uganda that employs a market-based approach, the main challenge relates to delays in getting bank loans for entrepreneurs. Sanitation entrepreneurs identified cannot begin operating their businesses until they receive funding through bank loans. It has been observed that banks have limited information on the viability of small businesses in the sanitation sector (UWASANET 2012)

When considering insurance as a risk management mechanism to increase sustainability of water and sanitation services per se, one needs to be aware about the existing challenges with collection efficiency and limitations of cost recovery of services in water and sanitation in general (Zeug 2011). Sustainable cost-recovery mechanisms are essential to provide an environment where private sector can operate. Core funding for the sector can come from three main sources: tariffs (from households as users of the service), taxes (from domestic taxpayers via government institutions) and transfers (from entities that make voluntary contributions, such as international donors or philanthropic organizations). Repayable financing from private or public sources can also be used to bridge a temporary funding gap (Tremolet and Rama 2012). The difficulty of implementing cost recovery mechanisms is partly due to the perception of WS services as a free commodity. The reported rates of non-functionality across the sector, which are as high as 30-40% (Lockwood & Smits 2012), provide a strong signal that existing mechanisms for financing capital maintenance are inadequate. Long-term maintenance is often left to entities from outside the community, e.g. local or national government, NGOs, donor projects and programmes to step in with rehabilitation works (Fonseca 2012). Operation and maintenance of water and sanitation infrastructure over time is poor, resulting in system failures and wasted donor and government investment (Willets et al 2008).

In conclusion, to encourage private sector involvement to share risks and profits in the water and sanitation sector requires institutional and technical capacity, something that is not available in developing countries. Mechanisms for this to happen are not simplistic business models and require collaborative institutional development in order to further develop the sector. Insurance in general remains a market failure in the developing world. At the same time it should be a goal in

development to create private/public partnerships in order to catalyse investments in more resilient DRR solutions.

4. Catalyzing the development of PPP in water management to reduce disaster risk

From the above gap analysis it is clear that integrating disaster risk reduction in PPP investments, means looking more specifically into *what, where, and how* that investment is made making sure others are also investing in the whole interlinked system. As we have described above, engaging in a development-oriented PPP can in fact *increase* disaster risk instead of decreasing it. Instead there may be a few principles to take into consideration, which firstly can give an initial assessment if a project is going to reduce risks or not, and secondly catalyze the development of PPPs in water management to reduce water-related disaster risks.

4.1 ACCESS

Bridging the playing field to empower local entrepreneurs and community groups, improving communication and building trust, could boost learning between stakeholders and building up of long-term institutional capacity.

Bridging the divide between the formal networks and the *ad hoc* provision to unplanned informal and illegal settlements has promising solutions. Small-scale local service providers such as CBOs has found ways which work in these areas, which should be capitalized on more by the formal network services and city managers. Also, legalising and formalising small (now illegal/informal) operators has been done for example in Phnom Penh, Cambodia and in Mozambique. This would ensure they provide an adequate service at a regulated price, in return for being able to run a legal business (Mara and Evans 2011) and enable important risk reducing measures through making them subject to quality control and improvement of the water sources. In Maputo, the water regulator CRA (Water Regulatory Council, also dealing with sanitation regulation) is assisting these private operators to control the quality of their water sources (personal communication Manuel Alvarinho).

As PPP relationships with community groups or small private operators is many times seen as a risky (unknown) territory, and many would not commit to a larger project initially, a phasing-in approach could be a way to build trust, by awarding clear and focused short-term contracts with the option of converting to a concession contract at a later date (Lamb et al 2004). Other success factors from case studies of insurance in Uganda and Zimbabwe (Mosely et al 2003 in Zeug 2011) points to the important role of charismatic leadership, capable institutions and most of all, satisfactory performance in relation to what was expected. Demonstrated loyalty and better-than-expected performance strengthen the development of trust. Evidence of exploitation and under-performance undermine the development of trust (Zeug 2011). Therefore, not creating big expectations at the beginning of a project may be of help later on when the parties of the PPP (especially communities) do the accounts.

Accountable, democratic institutions that could design and manage PPPs for disaster risk reduction provides a good foundation. Local governments face the challenge of designing and implementing PPP contracts with private sector partners who may have much greater technical expertise and knowledge of the project requirements. In the OECD a suggestion is to minimise this information asymmetry, by national governments providing technical assistance to cities. This could take the form of what has been called “dedicated PPP units”, specialised public bodies with PPP experts, which already operate at the national level in several OECD countries to increase the capacity of the public sector in engaging in PPPs (OECD 2012). Redesigning this support for developing countries would need to include capacity of pro poor business model, and tailor-make PPPs for the collaboration with community groups and local small-scale service providers.

Institutional capacity building, also means understanding how mainstream institutions should address the poorer segment of society, and learn how to adapt the governance system and design activities which are not promoted by the mainstream development. However, it requires that the leaders need to think out of the box and becoming more brave and bold to do something innovative. Existing demonstration sites exist which can be replicated, although their importance has not yet been realised, where lessons learnt could be synthesised and disseminated to local planners. For example, in response to the extreme flood in 2000 in Mozambique, Médicos sem Fronteiras (MSF) Belgium decided to implement an integrated WASH system in the high risk suburb in Maputo city called Urbanização, instead of ‘fire-fighting’ cholera year after year. Humanitarian funds became available after the 2000 flood which they used to set up a local CBO to put in and manage communal WSS infrastructure (septic tanks and somewhat adapted pit latrines) and set up a local drama group which promoted hygiene. A small-scale surface and subsurface drainage system was built, criss-crossing the neighbourhood, along side its narrow streets, and solid waste is collected by the community to keep the drains clear. Small carts are used to collect the solid waste and put it in the nearest municipal container. The CBO now also acts as a service provider to empty the septic tanks and latrines and by doing so collecting revenue for cost recovery (Thomson; personal communication Marculino Chemane). In this case the initiative came from an iNGO, but there is nothing stopping these kinds of projects to be initiated by local governments. An iNGO or NGO could for example help set up the local CBO. Thinking much more creatively about partnerships and having the courage to try out new solutions could go a long way to build institutional capacity, and to strengthen DRR at the local level.

4.2 SITING & OPTIONS

Multiple sanitation options need to be promoted including those which are fit to cope with challenging environments e.g. floods or water scarcity. This includes knowledge on suitable locations and future impact from e.g. climate change. Improved knowledge and governance is needed to help put the right solution in the right place.

Drainage & sanitation solutions

Without proper arrangements for stormwater drainage, complete and effective urban sanitation cannot be achieved. There are options for low-cost stormwater drainage, with

considerations for different types of urban environment characterised by specific topographies and ground slopes (Parkinson et al 2007).

There are also alternatives to conventional sewerage. For example, simplified sewerage conveys unsettled wastewater and is a promising low-cost option which has shown to be (evidence from a few cases) more cost efficient than on site sanitation. Simplified sewerage is essentially conventional sewerage, sometimes called condominial sewerage, which is suitable for planned and unplanned areas, where it can also be retrofitted (Mara presentations). Basically, non-conventional sewers use small diameter pipes laid at shallow depths and relatively low gradients, just adequate for sewage to flow by gravity (Sundaravadivel et al 1999). Low-cost combined sewerage is expected to become more widely used as the incidence of flooding increases. Combined sewerage is a sewer system that receives both domestic or municipal wastewater and stormwater. Usually these sewers are designed to receive the stormwater flow which results from a 10-year flood. This sanitation option is especially suitable for low-income coastal areas subject to regular annual flooding, but also where it is cheaper than simplified or settled sewerage and separate stormwater drainage (Mara). The city of Salvador, capital of the Brazilian state of Bahia, has one of the largest simplified sewerage systems in the country (Melo 2005). There, It was found that, in children under five the prevalence of *Ascaris lumbricoides* infection was reduced from 24 to 12%, *Trichuris trichuria* from 18 to 5% and *Giardia duodenalis* from 14 to 5%. Most of this reduction appeared to be explained by the increased coverage of each neighborhood by the sewerage system constructed during the intervention. The key explanatory variable was thus an ecological measure of exposure and not household-based, suggesting that the parasite transmission prevented by the program was mainly in the public (as opposed to the domestic) domain (Barreto et al 2010). However, making sure that rivers do not end up being the end deposit station for sewage outlets is important.

There are also more adequate septic tank solutions. For example, DEWATS − Decentralized Wastewater Treatment Systems – is basically an advanced septic tank. DEWATS applications are designed to be low-maintenance. The most important parts of the system work without technical energy inputs and cannot be switched off intentionally. DEWATS applications provide state-of-the-art technology at affordable prices because all of the materials used for construction are locally available (DEWATS website) and an appropriate option for in treatment of domestic wastewater in low-income communities (Foxon et al 2006). We will not go through all the sanitation options here, but these are illustrations of different technologies which are low cost and should be better known to both planners and promoted by the private sector for the benefit of low-income areas. Encouraging more experimentation in projects could test these and other innovative technologies and approaches including promoting CLTS (Community Led Total Sanitation), and more environment-friendly solutions including reuse. NGOs could help support these pilots and help subsidize technologies, which need to find their way into a market (Wadström personal communication).

Emergencies (situations where coping measures are put in) provide opportunities for experimenting. These are now being championed by a few humanitarian agencies realising the need for innovation into alternative more robust technologies that can be kept functioning even during extreme weather events (Johannessen 2011). For example, Oxfam GB found that raised pit latrines were more appropriate in flood and cyclone prone areas and

more widely accepted by the community than by other technologies (Morshed and Sobhan 2010). However these are on site options, which are useful for the humanitarian response phase only and should be phased out and replaced by more permanent solutions with time. Raised latrines enable for example reuse and urine diversion to be used over time. There is a great opportunity in managing such transitions into the development phase much better, and to empower local communities in using these new more sustainable and resilient technologies.

Governance tools

Governance tools include improved land-use regulation, zoning, land tenure and building codes, with associated quality control and enforcement where traditional urban planning tools are key to locating the right option in the right place. Addressing these tools more proactively and not only as a response to disasters would make a big difference. If cities have not experienced a great disaster, but are in the risk zone from e.g. tsunamis, they should take action and learn from other cities' experience. Provisions can be made more accessible to planners by making legal requirements. For example in South Africa's Water Act (1998), a 100-year flood is now required to be included in plans (Stephenson 2002). There is also a need to improve quality control mechanisms to include sanitation expertise in the technical committees evaluating EIAs and approving development projects. The follow up after an EIA to control compliance would also be a key measure to ensure that corners are not cut at the end of the housing construction process (Johannessen notes from focus group discussions with CLASS-A). Also, all institutions which deal with urban housing development should be informed of the need to adapt to different challenging conditions in a city, and the bare minimum would be to at least consider WASH activities.

Knowledge and learning

To make efficient use of existing knowledge, the right knowledge needs to be made available at the right place at the right time. Networking and cross-learning can solve some of the most critical knowledge deficits, integrate existing knowledge and trigger much innovation. To build more beneficial environments for collaboration, some cities have piloted the setting up of city-wide 'learning alliances' as platforms (Sutherland et al 2012) for scaling up of successful innovations. These have not focused on PPPs per se, but this could perhaps be an idea. Cities could in such way learn to understand what constitutes an enabling environment for private players and how this could be created. These structures would also be useful to scale up pro-poor business models. Bringing in people who operate small businesses in slum areas to understand better the 'customer base' and their motivating drivers would be potentially very valuable. In addition, there should be more active efforts to have different communities of practice get together to stimulate innovation. For example, engineers associations could start interacting with architects associations and start a dialogue over how to improve WASH planning and construction. Such cross-learning could focus on contingency planning, disaster preparedness strategies and financial risk management to prepare better against major shocks undermining water and sanitation services in developing countries (Zeug).

4.3 MITIGATION and ADAPTATION

There needs to be more emphasis on ecosystem management for (urban) DRR and incentives to invest, realising that conventional infrastructure solutions like structural flood barriers can create new vulnerabilities with negative impacts and also increase maintenance costs.

On the global scene, green growth is on the rise, where sustainable development, DRR, climate adaptation, community mobilization and resilience come together. Many today encourage the mobilisation of approaches such as “green cities” and which also can attract investments and citizens. In terms of DRR there is still an overemphasis on response efforts with companies, and many businesses should look more deeply into working with prevention and mitigation. Doing this, they could play a very important role in influencing governments to do more in terms of holistic management of risks at the river basin level which otherwise could jeopardize their assets. Just recall the large private sector economic losses in the last Bangkok flood in 2011. More and more resilience in urban energy, water, and transportation infrastructure will contribute to urban attractiveness as firms are likely to factor the long-term reliability of these services into their siting decisions (OECD 2012).

Through global fora and networking there are huge opportunities in learning from other companies and communities of practice in other cities and in other countries. Investment strategies in low income countries have an opportunity of contributing to incremental changes in development, by using modern technology e.g information and communication technologies (ICT) to support sustainable outcomes. There are a multitude of different quality assurance approaches and methodologies which can contribute to a company’s ‘Social licence to operate’, for example corporate citizenship/governance, CSR, sustainable development, good business values and brand/reputation. This can be done through a business’ own initiatives e.g. the Global Reporting Initiative (GRI), the UN Global Compact, ISO-standards, and many more national and international mechanisms. International companies can learn from mother companies/trading partners through reputation assurance from head offices, and adoption by companies of voluntary codes of conduct. However, while these approaches are viewed by companies as a strategic tool for promotion of reputation and brand value, there is a risk that its potential to generate spin-offs can be at the expense of real change (Enell personal comment).

Sometimes major events are needed to really trigger investments in ecosystem services. Such events represent windows of opportunity for actors to initiate these types of measures. This has been the case in for example coastal mangrove restoration in the Indian Ocean after the tsunami in 2004 and reforestation programmes to mitigate flooding. For example in China, following severe Yangtze River flooding in 1999, the government committed to invest over US$40 billion in the Sloping Land Conversion Programme to allow for reforestation along the river to decrease erosion and mitigate flood impacts (Bennett and Xu 2007; ;Tallis et al. 2008 in Ten Brink et al 2012)

To integrate DRR before natural hazardous events occur, governments or cities could promote different urban planning tools, which would encourage the development of private sector codes of conduct, such as *sustainability certification of urban areas*. Such tools can be adapted to the national context. For example, the Swedish project for Sustainability

Certification of Urban Areas (Projektet Hållbarhetscertifiering av Stadsdelar - HCS www.hallplatsen.nu), is a collaboration between Swedish government departments, municipalities, building companies, property owners, consultants, architects, energy companies, researchers etc. This project is studying international systems for sustainability certification of city areas, and evaluates the systems promoted by BREEAM communities to adapt the systems to the Swedish context, potentially to be recommended by the Swedish Green Building Council (www.sgbc.se) (Karlsson 2012). Such tools could also be adapted to integrate risk criteria, which has not yet been done, e.g. by looking at drainage and runoff, assessing flood risk, reducing heat absorption and the need for powered cooling, and ensuring weather-resilient development.

The result of these tools can apart from integrating DRR in planning actually also save money, as well as generate positive side effects. Miami, USA has used the *CITYgreen Tool* for systematically including green infrastructure such as parks, urban forests and wetlands into urban planning. This is mainly for the purpose of storm water protection, enhancement of air- and water quality and climate regulation. As a result a riverine area was rehabilitated which subsequently generated a range of positive side effects (e.g. recreational and property values) (TEEBcase by Förster 2010).

Strategic Environmental Assessments or Ecosystem Assessment are very important to support investment decisions, including assessing the value of an ecosystem service, and comparing it with alternative investments. For example in the outskirts of Kampala, Uganda, the Nakivubo Swamps provide an important ecosystem service of treating and filtering the biological waste water from much of the city. Ideas to drain the wetland in order to gain agricultural land were dropped when an assessment of this service showed that running a sewage treatment facility with the same capacity as the swamp would cost the city around 2 million US$ annually (TEEB case by Almack 2010). Swamps also provide multiple benefits which were not even included in this calculation. Belgium provides another example where a strategic assessment favoured the restoration of approximately 5500 ha of the Scheldt Estuary, dike reinforcement and dredging instead of a storm surge barrier to meet flood risk. This solution was chosen as it had an estimated payback of 14 years; to be compared with the payback of the storm surge barrier which was 41 years (De Nocker et al 2004, Meire et al. 2005, Broekx et al. 2010).

An ecosystem assessment exercise can also encompass integration of planning in general. For example an assessment of the city of Cape Town's ecosystem services highlighted their crucial role in a number of areas, ranging from tourism, where the link is obvious, to wastewater treatment and protection from natural hazards, where the role of ecosystems can more easily go unnoticed. One of the key lessons of this case is that it was the process of jointly engaging in the analysis with various municipal departments which was most beneficial. It was valuable to build a shared understanding of Cape Town's ecosystems as natural assets, and thereby prepare the ground for future efforts to better secure their maintenance and protection (De Wit and van Zyl 2011; De Wit et al. 2009).

Private sector urban financing is increasingly being used for green infrastructure projects. Three conditions help make this possible and determine their success:

- ensuring sufficient return in order to balance the risk (matching the right financing tool to the risk);
- scaling the project to be large enough to lower transaction costs, increase returns and attract investment; and
- guaranteeing competitive pricing signals for green technologies used.

These provide incentives to reduce the uncertainty related to urban green growth projects. The high level of uncertainty characteristic in green projects increases the insecurity and instability of the PPP. Certain national governments (e.g. South Korea) have put in place financial transfer and incentive measures to eliminate some of this uncertainty and stimulate urban green growth PPPs (OECD 2012). South Korea implements various kinds of financial and tax incentive policies that can facilitate green growth PPP financing, in line with its First Five-Year Action Plan for Green Growth initiated in 2009. More specifically, the government provides (i) construction subsidies, (ii) compensation for base cost, (iii) infrastructure credit guarantees via the Infrastructure Credit Guarantee Fund, and (iv) tax incentives (OECD 2012).

Reducing corruption
To improve the performance of water and sanitation utilities, many governments have undertaken major restructuring of the sector. Two approaches that directly address governance structures and institutional incentives and PPPs have been adopted. One is to split up large national agencies and decentralize construction, operation, and maintenance to locally managed companies. The other is to bring in the private sector through management contracts, concessions arrangements, or a complete divestiture. Each approach has its proponents (de Asis et al 2009).

4.4 SHARING

PPPs should be seen as ways of stabilizing urban development and providing long-term resilience and reduction of social vulnerabilities. This requires mechanisms whereby risk and profits can be shared between the private and public sectors.

Different sharing mechanisms exist for cross-subsidy, pooling of resources and triggering snowball effects and supporting instruments. Sharing of costs between richer neighbourhoods and poorer ones can be done for example by government putting up conditions for service contracts which combine profitable projects with unprofitable ones to enable cross-subsidy to benefit poorer communities. For example in Manila, the Philippines, two separate concessions regarding water supply were granted, which meant that cross-subsidy was not possible and the concession covering some of the poorer areas of the city actually imposed higher tariffs than the concession covering the other half of the metropolis (Johnstone and Wood 2001 in Koppenjan and Enserink 2009). Pooling of resources can be carried out with other private stakeholders to decide what is the best solution concerning for example a local catchment. Engaging local planners can be done by addressing issues which really motivate them, concerning the whole city's success for economic development, not only the poor areas. Through building the institutional capacity, and increasing market shares for sanitation in the city, this can pull together finances, engage more people employed in the sector, provide better education, increase demand for products, and not

least bring forward people who can stimulate needed measures such as cross-subsidy arrangements benefiting poorer neighbourhoods. Such snowball effects are largely unexplored. Supporting instruments, like social funds and livelihood programmes, can enable communities to make investments which are vital for building resilience to make a transition into new livelihoods, often in new sectors and in urban areas where they may need temporary support. This can be combined with safety nets in the form of cash transfers, (both conditional and unconditional) workforce programs and in-kind transfers. For example, in Honduras, an existing social fund was able to scale up labor-intensive community projects after Hurricane Mitch. Within a few months, these projects created a large amount of temporary employment in communities where infrastructure had been disrupted by the hurricane (Grosh et al. 2008).

Avoid moral hazards and support informal systems. For schemes which aim to build resilience, it is however a very important consideration to address moral hazards, to avoid disincentive local entrepreneurs and to strengthen the perception of WASH services as a free commodity. Supporting instruments can also constitute a moral hazard, as communities often do not find it worthwhile to invest in operations and maintenance for DRR,since they know that when there is a breakdown, governments or NGOs will come to the rescue. This provides a further disincentive for communities to take responsibility for DRR in addition to the common approach of not dealing with large maintenance until failures occur (Fonseca et al. 2012).

When social security nets such as insurance systems are being introduced it is important that already informal systems are not destroyed, a lessons learnt from European social history (Lindbeck 2008). Developing countries have a long history of informal insurance systems, for example reliance on neighbors / families during disasters which is important to strengthen resilience against water-related disasters. In Bangladesh people who have lost their homes due to flooding are in some cases allowed to rebuild on other people's land, under the assumption that the favor will be returned one day (Hoff et al 2003).

Trust. One key success factor for these schemes to work at the CBO level is to start off with a base of people who trust each other based on their familial relationships and the proven success of a credit scheme (UN 2006).

Insurance industry. On the global level, a number of high ranking insurance companies have formed initiatives to promote collaboration with policy makers on the subject of climate change adaptation, risk management and development as part of ongoing UNFCCC negotiations (ClimateWise et al. 2010). A key demand of these initiatives is that governments learn to convene and seed regional public-private partnerships which address risk reduction and risk transfer (ibid). Moreover as part of the UNEP finance initiative for principles of sustainable insurance, global insurance companies have committed themselves to working closer together with government, regulators and other stakeholders to help to develop regulatory and legal frameworks that enable risk reduction and risk management (UNEP 2012). Increasingly insurances are looking towards greater coordination and collaboration with governmental authorities for risk management to respond to environmental risks e.g. climate change impacts (Mills et al. 2005). Cooperation between insurance industry and the public sector can take place in joint knowledge and capacity building. In Germany for example, the insurance industry has been receiving data

from local water authorities to develop a flood risk database that assigns a certain flood risk category to every single estate in the country (Keskitalo et al. in press).

Microinsurance schemes. These normally involve a number of partners from the private sector, governments, NGOs and others. They are increasingly seen as a way forward in risk spreading and transfer. These schemes are particularly important in places where people are not bankable. In many developing countries less than half the population has access to formal financial services, and in most of Africa less than one in five households has access (Beck et al 2009). There are two main varieties of microinsurance – one focused on extending social protection to the poor in the absence of appropriate government schemes and the other offering a vital financial service to low-income households by developing an appropriate business model that enables the poor to be a profitable (or sustainable) market segment for commercial or cooperative insurers (Churchill 2006). For example, an application of microfinance is the Local Development Program (PRODEL) in Nicaragua which lends to community groups for small infrastructure projects (Baker 2012). The last two decades have seen a flurry of risk transfer innovations, driven by the private sector but also by the international community at large. The result is a broader set of options for disaster risk financing and insurance at all scopes in developing countries. A few innovative pilots are under development. For example in 2011, a consortium of partners announced the formation of the Microinsurance Catastrophe Risk Organization (MiCRO), a disaster microinsurance facility for Haiti's micro-entrepreneurs. A review of microfinance programs for water and sanitation suggests that there is a large potential demand for microfinance, however while there are many pilot projects, very few have achieved scale. However, micro finance institutes show a low interest in the water and sanitation sector, especially urban sanitation, for it continues to be relatively unknown and is perceived as high risk (Mehta 2008).

Microinsurance for health, seems to have a much bigger chance for a growing market than insurance for WASH systems per se. However, indirectly, microinsurance can play a great role for WASH systems. Risk of eviction is one of the biggest barriers for infrastructure development in slums and microinsurance in housing could help to manage this risk better. For example, in slum areas of Dhaka, Bangladesh persons managing 'water houses' providing WASH services would see an insurance as an incentive to improve the facilities, which often is of poorest quality and very unhygienic (Zeug 2011).

Sectoral self-insurance is an interesting idea with further scope for replication and adaptation for the developing country context as major shocks to water and wastewater services are difficult to tackle for utilities in the urban environment, small towns and community water supply systems in rural areas. For example, UK water utilities sign mutual help agreements to prepare for disaster events. The Mutual Aid Scheme allows water service providers to request assistance from other water companies in case of a low key event, a major event or an emergency. The assistance ranges from the provision of bottled water supplies, tankers, equipment or specialist staff (Zeug 2011).

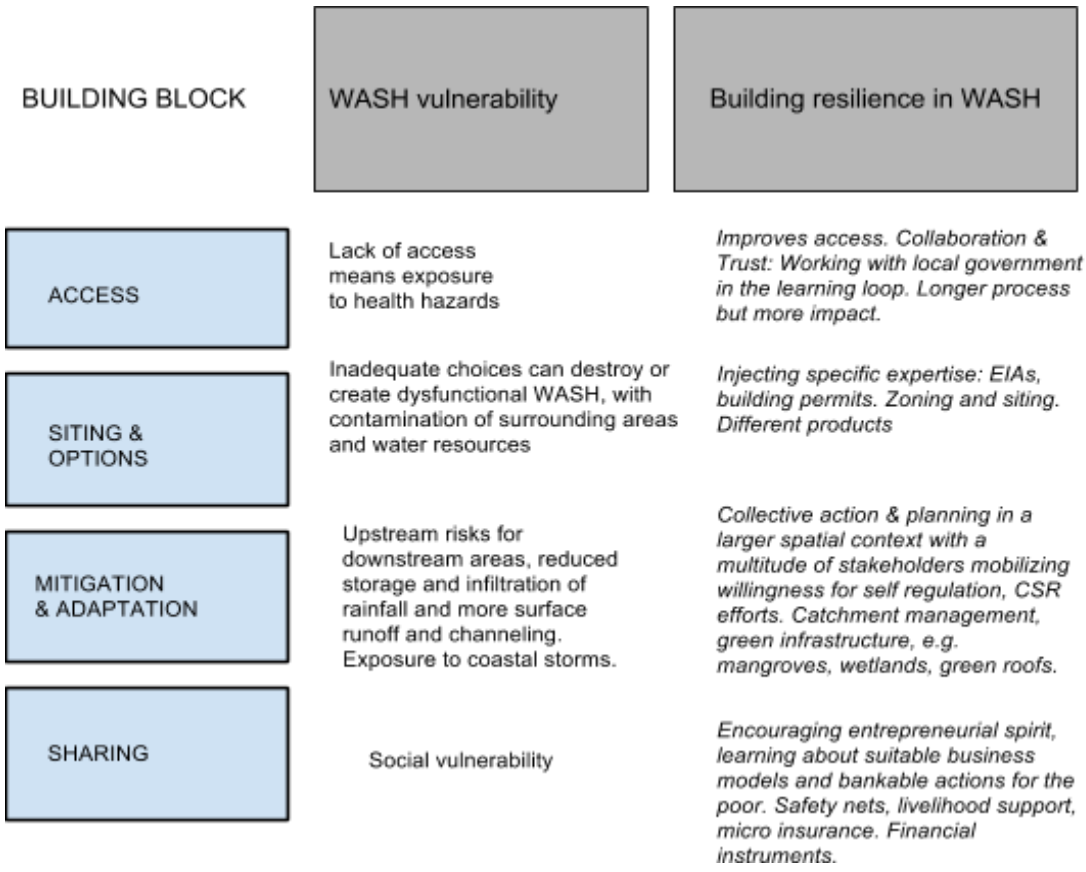


Figure 3: Summary table of the areas where PPPs could provide increased resilience in urban capital investments, some social learning mechanisms and effect on the risk reduction.

5. Conclusions

Stimulating a citywide initiative to PPP in WASH is key to be able to provide efficient mechanisms for access, siting, adaptation and sharing which are the four building blocks which we think are crucial to building resilience (Figure 3). Bridging the divide between different stakeholders and motivating a change in attitudes to empower local entrepreneurs and community groups, requires initiative from the city leadership level and political signals to create enabling organisational cultures working towards common goals. Issues of accountability are crucial, and the risk assessment process which often is part of risk management, will need to engage local stakeholders, not only once, but in an iterative process to come to mutual agreements of what needs to be done and how, really triggering action. Self assessments and soft systems methodologies for participation (Checkland 2000) are ways of exploring issues in depth and at the same time mobilizing ownership, accountability and action by putting the right system in the right place. City managers must become aware of the slow processes at work, which are preventable through better governance, i.e. to enable city stakeholders including the private sector to step in and contribute in the space which would otherwise only build more vulnerability. Action through experimentation must also be more encouraged, acknowledged and rewarded within organisations to stimulate innovation through learning from (multiple) failures. Vision is

required to mobilize the boldness of trying to change existing realities, to meet the resistance this entails, but it also includes having faith in the process and belief that something can come through collective action. It is not an easy task, but the consequences of the wait and see approach and not acting has shown itself to be disastrous.

6. References

ADB. 2006. Expanding access to basic services in Asia and the pacific region: Public Private Partnerships for poverty reduction. Adrian P. PANGGABEAN. ERD - Economics and Research Department. Working Paper SERIES No.87
http://www.adb.org/sites/default/files/pub/2006/WP087.pdf

Adger, N. 1999. Social Vulnerability to Climate Change and Extremes in Coastal Vietnam. World
Development 2, 249-269

Almack K. (2010). 'River restoration to avoid flood damage, USA',
http://www.eea.europa.eu/atlas/teeb/riverrestoration-to-avoid-flood-1

APFM. 2009. The Associated Programme on Flood Management (APFM) concept paper, [online] URL: http://www.apfm.info/pdf/concept_paper_e.pdf . WMO-No. 1047

Baker, J.L. and McClain, K. 2009. Private Sector Initiatives in Slum Upgrading.THE WORLD BANK GROUP WASHINGTON, D.C.; URBAN SECTOR BOARD; URBAN PAPERS. UP-8. MAY 2009.
http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1169585750379/UP-8.pdf

Baker J.L. 2012. Climate change disaster risk and the urban poor, Cities Building Resilience for a Changing World. The International Bank for Reconstruction and Development / The World Bank. Urban Development Series.

Bakker, K. 2003. Archipelagos and networks: urbanization and water privatization in the South. The Geographical Journal, 169: 328–341. doi: 10.1111/j.0016-7398.2003.00097.x

Barreto, M.L., Genser, B., Strina, A., Teixeira,M.G., Assis, A.M.O, Rego, R.F., Teles, C.A., Prado, M.S., Matos, S.M.A., Alcântara-Neves, N.M., Cairncross, S. 2010. Impact of a Citywide Sanitation Program in Northeast Brazil on Intestinal Parasites Infection in Young Children. Environ Health Perspect. 118(11): 1637–1642. Found online 2012-11-27
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2974706/

Bartram, J., Cairncross, S. 2010. Hygiene, Sanitation, and Water: Forgotten Foundations of Health. PLoS Med 7(11): e1000367.doi:10.1371/journal.pmed.1000367

Batley. R. 2006. Engaged or divorced? Cross-service findings on government relations with non-state service providers. Public administration and development. 26, 241–251; DOI: 10.1002/pad.422

Bea, Robert and Edward Link. Interview. "How Will New Orleans' Levees Be Fixed?." Talk of the Nation. NPR. 6 June 2006. Web. 4 Nov. 2010. <http://www.npr.org/templates/story/story.php?storyId=5452056>.

Beck, T., A. Demirgüç-Kunt and P. Honohan. 2009. Access to Financial Services: Measurement, Impact, and Policies. World Bank Res Obs (2009) 24(1): 119-145.doi: 10.1093/wbro/lkn008

Bennett, M. T. and Xu, J. (2008) 'China's sloping land conversion program: Institutional innovation or business as usual?' Ecological Economics, vol 65, no 4, pp699-711, URL: www.cifor.cgiar.org/pes/publications/pdf_files/China_paper.pdf

Berghman, L. 2006. Strategic Innovation Capacity - A Mixed Method Study on Deliberate Strategic Learning Mechanisms. Erasmus Universiteit Rotterdam, PhD dissertation.

Berkes, F. and Jolly, D. (2001) Adapting to Climate Change: Social-Ecological Resilience in a Canadian Western Arctic Community. Conservation Ecology 5(2):18. [online] URL:http://www.consecolorg/vol5/iss2/art18

Bizimana, J. P. and Schilling, M. 2010. Chapter 6. Geo-Information Technology for Infrastructural Flood Risk Analysis in Unplanned Settlements: A Case Study of Informal Settlement Flood Risk in the Nyabugogo Flood Plain, Kigali City, Rwanda. In: P.S. Showalter, Y. Lu (eds.), Geospatial Techniques in Urban Hazard and Disaster Analysis, 99 Geotechnologies and the Environment 2, DOI 10.1007/978-90-481-2238-7_6

Blaikie, P., Cannon, T., Davis, I. and Wisner, B. 1994. At Risk: Natural Hazards, People's Vulnerability, and Disasters. London: Routledge.

Blackmore, C. Ison, R. Jiggins, J. (2007) Social learning: an alternative policy instrument for managing in the context of Europe's water. Environmental Science & Policy 10(6): 493-498.

Bonnardeaux, D. 2009. The Cochabamba "Water War": An Anti-Privatisation Poster Child? 9p. From http://www.policynetwork.net/sites/default/files/Cochabamba_March09.pdf

Boyle, J. 1998. Environmental Impact Assessment Review, Volume 18, Issue 2, March 1998, Pages 95–116. Cultural influences on implementing environmental impact assessment: insights from Thailand, Indonesia, and Malaysia.

Broekx S., Smets S., Liekens I., Bulckaen D. and De Nocker L. 2010.'Designing a long-term flood risk management plan for the Scheldt estuary using a risk-based approach', Natural Hazards

Brooks, N. 2003. Vulnerability, risk and adaptation: A conceptual framework. Tyndall centre for climate change research. Working paper 38.

Brown, T.1984. The concept of value in resource allocation. Land Econ 60, 231–246

Budds, J. and McGranahan, G. 2003. Privatization and the provision of urban water and sanitation in Africa, Asia and Latin America. International Institute for Environment and Development (IIED) http://www.acquaevita.info/pag/pdf/Water_dp1.pdf

Burra, S., Patel, S. and Kerr, T. 2003. Community-designed, built and managed toilet blocks in Indian cities. Environment and Urbanization. 15(2):11-32.

Bush, R., Bujra, J. and Littlejohn, G. 2011. The accumulation of dispossession, Review of African Political Economy 38:128: 187- 192

Butterworth, J. and M. Morris, 2007,Developing Processes for Delivering Demand-Led Research in Urban Water Management. SWITCH Report Available at: http://www.switchurbanwater.eu/outputs/pdfs/W6-2_GEN_RPT_D6.2.10a_Consolidation_report_on_learning_alliances.pdf

Cabral R.B., Alino P.M. 2011. Transition from common to private coasts: Consequences of privatization of the coastal commons. Ocean and Coastal Management 54(1):66-74.

Cannon, T. 1994. Chapter 2. Vulnerability analysis and explanation of 'Natural' Disasters. Disasters, Development and Environment. Ed by Ann Varley. John Wiley & Sons Ltd

Chan, N.W. 1997. Increasing flood risk in Malaysia: causes and solutions. Disaster Prevention and Management 6(2):72 - 86.

Chang, M., Mushtaq Ahmed Menon and Hidefumi Imura. 2003. International Experience of Public – Private Partnerships for Urban Environmental Infrastructure, and Its Application to China. International Review for Environmental Strategies 4 (2): 223 – 48 .

Charitou, C.D. and Markides, C.C. 2003. Responses to disruptive strategic innovation. MIT Sloan Management Review 44 (2): 55-63

Checkland, P. 2000. Soft systems methodology: A Thirty Year Retrospective. Syst.Res. 17, Pp11-58.

Churchill. 2006. Protecting the poor. A microinsurance compendium, supported by MunichRe Foundation and ILO. http://www.munichre-foundation.org/dms/MRS/Documents/ProtectingthepoorAmicroinsurancecompendiumFullBook.pdf

Clapp, C. et al. 2011. Cities and Carbon Market Finance. Taking Stock of Cities' Experience with Clean Development Mechanism (CDM) and Joint Implementation (JI). OECD/CDC, Paris.

Clarke, G. R. G. et al. (2004), “Has Private Participation in Water and Sewerage Improved Coverage? Empirical Evidence from Latin America”, World Bank Policy Research Working Paper 3445

ClimateWise; The Geneva Association, The Munich Climate Insurance Initiative (MCII) United Nations Environment Programme Finance Initative (UNEP FI) (2010): Global insurance industry statement on Adapting to climate change in developing countries. Available online at http://www.climate-insurance.org/upload/pdf/201009_Global_Insurance_Industry_Group_Statement_on_Adaptation_in_Developing_Countries.pdf, updated on 6/10/2010, checked on 29/07/2012.

Cooper, M. 2012. Public-Private Collaboration: Six Years After Hurricane Katrina. http://bclc.uschamber.com/blog/2012-06-20/public-private-collaboration-six-years-after-hurricane-katrina In: The Role of Business in Disaster Response Report. Published by US Chamber of Commerce, Business Civic Leadership Center.

Copeland, C. 2005. “Hurricane-Damaged Drinking Water and Wastewater Facilties: Impacts, Needs, and Responses.” Congressional Research Service.<http://www.policyarchive.org/handle/10207/bitstreams/4235.pdf>

C40 Climate Leadership Group and ARUP. 2011. Climate Action in Megacities: C40 Cities Baseline and Opportunities Version 1.0, C40 Climate Leadership Group, available at:www.arup.com/Publications/Climate_Action_in_Megacities.aspx.

de Asís, M.G., D. O’Leary, P. Ljung, J. Butterworth. 2009. Transparency, Integrity, and Accountability in Water Supply and Sanitation Action, Learning, Experiences. The World Bank Institute and Transparency International. Found online 2012-11-28. http://www.oecd.org/env/environmentinemergingandtransitioneconomies/44475062.pdf

De Bruijn, K.M. and Klijn, F. (2001). Resilient Flood Risk Management Strategies. In: L. Guifen and L.Wenxue, (eds.), Proceedings of the IAHR congress, September 16–21, 2001, Beijing China, ISBN 7-302-04676-X/TV Tsinghua University press, Beijing, 2001, pp. 450–457.

De Nocker L., Broekx S. and Liekens I. (2004) Maatschappelijke kosten-batenanalyse voor de actualisatie van het Sigmaplan, Conclusies op hoofdlijnen, Tussentijds rapport in opdracht van
Ministerie van de Vlaamse Gemeenschap, LIN AWZ, Afdeling Zeeschelde, door Vito i.s.m. Tijdelijke Vereniging.

De Wit, M. P., H. Van Zyl, D. J. Crookes, J. N. Blignaut, T. Jayiya, V. Goiset, and B. K. Mahumani. 2009. Investing in natural assets. A business case for the environment in the City of Cape Town. Report prepared for the City of Cape Town, Cape Town, South Africa. [online]
URL:http://www.capetown.gov.za/en/EnvironmentalResourceManagement/publications/Documents/EnvResEconomics-Final_Report_2009-08-18.pdf

DFID. UK Aid. 2012. Water, Sanitation and Hygiene Portfolio Review. Accessed online 2012-12-14 http://www.dfid.gov.uk/Documents/DFID%20WASH%20Portfolio%20Review.pdf

Dokken, D.J., Ebi, K.L., M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. 20XX. A Special Report of Working Groups and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 1-19.

Dolisca F., McDaniel J.M., Teeter L.D., Jolly C.M. 2007. Land tenure, population pressure, and deforestation in Haiti: The case of Forêt des Pins Reserve. Journal of Forest Economics 13(4): 277-289.

Douglas, I., K. Alam, M. Maghenda, Y.Mcdonnell, L.Mclean and J.Campbell. Unjust waters: climate change, flooding and the urban poor in Africa. Environment and Urbanization 2008 20: 187

Eduljee, G. 1999. Risk assessment. In: Petts, J. (ed.) Handbook of Environmental Impact Assessment 1:374–404. Blackwell Science Ltd, London.

El-Fadl, K., El-Fadel., M. 2004.Comparative assessment of EIA systems in MENA countries: challenges and prospects. Environmental Impact Assessment Review Volume 24, Issue 6, August 2004, Pages 553–593

Everhart, S.S. and Sumlinski. M.A. 2001. Trends in Private Investment in Developing Countries: Statistics for 1970-2000 and the Impact on Private Investment of Corruption and the Quality of Public Investment, Del 63. World Bank Publications, 1 sep 2001 - 54 pp.

Falkenmark, M. and Folke, C. 2002. The ethics of socio-ecohydrological catchment management: towards hydrosolidarity. Hydrology and Earth System Sciences 6 (1):1-9.

Falkenmark, M. 2003. Water Management and Ecosystems: Living with Change. Global Water Partnership Technical Committee (TEC), TEC BACKGROUND PAPERS NO. 9

Few, R., G.T. Pham, Bui Thi Thuy Hong. 2004. Living with floods: health risks and coping strategies of the urban poor in Vietnam. Research report. A research project funded by British Academy (Committee for South East Asian Studies)

Finnveden, G. & Moberg, Å. (2005) Environmental systems analysis tools – an overview. Journal of Cleaner Production. 13, 1165–1173

Finnveden, G., Anna Björklund, Åsa Moberg, Tomas Ekvall and Åsa Moberg. 2007. Environmental and economic assessment methods for waste management decision-support:possibilities and limitations. Waste Manag Res 2007 25: 263

Fonseca, C., Smits, S., Nyarko, K., Naafs, A., Franceys, R. 2012. Financing capital maintenance of rural water supply systems: current practices and future options. IRC International Water and Sanitation Centre. October 2012, WASH Cost Working paper (draft)

Folke, C. (2006) Resilience: The emergence of a perspective for social-ecological systems analyses. Global Environmental change - Human and Policy Dimensions 16:253-267.

Foxon KM, Buckley CA, Brouckaert CJ, Dama P, Mtembu Z, Rodda N, Smith M, Pillay S, Arjun N, Lalbahadur T and Bux F. (2006) Evaluation of the Anaerobic Baffled Reactor for Sanitation in Dense Peri-urban Settlements. Water Research Commission Report No. 1248/1/06, ISBN 1-77005-371-9

Förster, J. (2010). Peatland restoration for carbon sequestration, Germany, Online: http://www.eea.europa.eu/atlas/teeb/peatlandrestoration-for-carbon-sequestration-germany-1/at_download/file

Gerger Swartling, Å., C. Lundholm, R. Plummer, D. Armitage (2011). Social Learning and Sustainability: Exploring Critical Issues in Relation to Environmental Change and Governance. SEI Project Report 2011, Mistra-SWECIA Working Paper No 5, SEI, Stockholm.
Guarin, G.P., Westen, C.J. and Montoya, L., 2004. Community-Based Flood Risk Assessment Using GIS for the Town of San Sebastián, Guatemala. International Institute for Geoinformation Science and Earth Observation (ITC).

Govindarajan, V. and Trimble, C. 2005. Organizational DNA for strategic innovation. California Management Review 47(3): 47-76.

Samuels P. & Gouldby, B. 2009. Language of Risk: Project Definitions. FLOODsite Report T32-04-01. http://www.floodsite.net. Accessed 2013-01-16 http://www.floodsite.net/html/partner_area/project_docs/T32_04_01_FLOODsite_Language_of_Risk_D32_2_v5_2_P1.pdf

Grosh, M., Del Ninno, C., Tesliuc, E., Ouerghi, A., 2008. For Protection and Promotion : The Design and Implementation of Effective Safety Nets, World Bank.

Gupta, T.N., 1994. Vulnerability of Houses in hazard Prone Areas, The World Conference on the International Decade for Natural Disaster Reduction (IDNDR), Yokohama, Japan; May 23–27, 1994.

Hall D. and E. Lobina 2012. Conflicts, companies, human rights and water - A critical review of local corporate practices and global corporate initiatives. Public Services International (PSI), London UK, for the 6th World Water Forum at Marseille. http://www.world-psi.org/sites/default/files/documents/research/psiru_conflicts_human_rights_and_water.pdf

Hardoy J.E. and D. Satterthwaite. 1991. Environmental problems of Third World cities: a global issue ignored? PUBLIC ADMINISTRATION AND DEVELOPMENT, VOI. 11,341-361 (1991)

Hargrove, R. 2002. Masterful Coaching, revised edition. Jossey Bass.

Harvey 2007. Harvey, P. 2007 (WEDC). Excreta disposal in emergencies. Available at www.wedc.lboro.ac.uk/publications

Harvey, P. 2009. Towards Good Humanitarian Government: The Role of the Affected State in Disaster Response. HPG Report 29, Overseas Development Institute.

Helm, P. (1996), "Integrated risk management for natural and technological disasters", Tephra,
Vol. 15 No. 1, pp. 4-13.

Heltberg, R., P. B. Siegel, S.L. Jorgensen. 2009. Addressing human vulnerability to climate change: Toward a 'no-regrets' approach. Global Environmental Change. Vol 19. 89-99

Hemming. R. 2006. Public-Private Partnerships, Government Guarantees, and Fiscal Risk, International Monetary Fund, 28 apr 2006 - 90 pp
http://www.google.se/books?hl=sv&lr=&id=J6jgbzGDAY0C&oi=fnd&pg=PR3&dq=public+private+partnerships+water+good+practice+sustainability+risk&ots=dd08_dJgkJ&sig=BCn_814kTS476bBBUv9aXz8Vd2Q&redir_esc=y#v=onepage&q&f=true

Hoff, H. , Laurens Bouwer, Gerhard Berz, Wolfgang Kron, Thomas Loster et al 2003. Risk Management in Water and Climate – the Role of Insurance and Other Financial Services online: http://germanwatch.org/download/klak/dwc2003.pdf

Hotez, P.J., Brindley, P.J., Bethony, J.M., King, C.H., Pearce, E.J. and Jacobson, J. 2008. Helminth infections: the great neglected tropical diseases. J. Clinical Investigation 118(4):1311−1321.

International Land Coalition 2011 Land Rights and the Rush For Land Report
http://www.landcoalition.org/cplstudies

IFRC. 2010. World Disasters Report - Focus on Urban Risk. 214p.

IPCC. 2012. Summary for Policymakers. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (Field, C.B., V. Barros, T.F. Stocker, D. Qin).
Johnstone, N. and Wood, L. 2001. Private Firms and Public Water: Realising Social and Environmental Objectives in Development Countries. Cheltenham, UK. Edward Elgar.

Johannessen. Å. 2011. Identifying gaps in emergency sanitation Design of new kits to increase effectiveness in emergencies 2 day Workshop, 22-23 February 2011, Stoutenburg, The Netherlands, Workshop report by Åse Johannessen. Organised by Oxfam GB and WASTE.

Jouravlev, A. 2004, "Drinking Water Supply and Sanitation Services on the Threshold of the XXI Century", CEPAL, Serie 74, Recursos Naturals e Infraestructura, Santiago de Chile, Chile, www.eclac.cl/publicaciones/ xml/9/19539/lcl2169i.pdf.

Kakonge. J. 2006.Environmental Planning in Sub-Saharan Africa: Environmental Impact Assessment at the Crossroads. Yale School of Forestry & Environmental Studies. Working paper no 9.

Karlsson, A. 2012. Innovative approaches to address DRR implementation in cities. Sustainability Certification of Urban Areas and opportunities to integrate resilience and DRR. Presentation at the Seminar 25/5 2012 on "Resilient cities - From knowledge to local action"Convened by the Swedish Water House cluster group for Water and Disaster Risk Reduction. 2013-01-16 Available at: https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnx3YXRlcmRycnxneDo3ZjA2NGQ2ZTgwOWFkMTFl

Keskitalo, E.C.H., Vulturius, G. and Scholten, P. (in press): Adaptation to climate change in the insurance sector: examples from the UK and the Netherlands and Germany. In Natural Hazard.

King, R.O. 2010. Earthquake Risk, Insurance, and Recovery: Issues for Congress. Congressional Research Service. 7-5700. R41109.

Kirkpatrick, C., D. Parker and Y-F. Zhang 2004. "State versus private sector provision of water services in developing countries: the evidence and a new analysis" (Manchester: Centre on Regulation and Competition, University of Manchester), mimeo.

Klein, C. A. and Zellmer, S. B. 2007. Mississippi River Stories: Lessons from a Century of Unnatural Disasters; 60 S.M.U. L. Rev. 1516

Klijn, F., M. van Buuren, S.A. M. van Rooij. 2004. Flood-risk Management Strategies for an Uncertain Future: Living with Rhine River Floods in The Netherlands? AMBIO: A Journal of the Human Environment, 33(3):141-147. 2004.

Koppenjan, J. F. M. and Enserink, B. 2009. Public–Private Partnerships in Urban Infrastructures: Reconciling Private Sector Participation and Sustainability. Public Administration Review, 69: 284–296. doi: 10.1111/j.1540-6210.2008.01974.x

Kundzewicz, Z.W. 2002. Non-structural Flood Protection and Sustainability. Water International, Volume 27, Number 1, Pages 3–13, March 2002

Lalbahadur, T. and Bux. F. 2006. The evaluation of the anaerobic baffled reactor for sanitation in dense peri-urban settlements. Report to the Water Research Commission, WRC Report No 1248/01/06. Accessed online 2012-11-27 http://www.wrc.org.za/Knowledge%20Hub%20Documents/Research%20Reports/1248-1-06.pdf

Lamb, J., L.Uzin, P.Gleick, G.Wolf and M. Panaliappan, R. Franceys, N.Scott. 2004. Implementation Guidelines for Private-Sector Participation in Sustainable Urban Water Supply and Sanitation Services. Draft. http://waterwiki.net/images/a/a0/Implementation_Guidelines_for_Private-Sector_Participation_in_Sustainable_Urban_WSS_services.pdf

Laxminarayan, R., Chow, J., Shahid-Salles, S.A. 2006. Intervention Cost-Effectiveness: Overview of Main Messages. Chapter 2 In: Jamison DT, Breman JG, Measham AR, Alleyne G, Claeson M, Evans DB, Jha P, Mills A, Musgrove P, editors. Disease Control Priorities in Developing Countries. 2006. 2nd edition. World Bank. Washington (DC).

Lebel, L., Manuta, J. and Khrutmuang, S. 2005. Risk reduction or distribution and recreation? : the politics of flood disaster management in Thailand. USER Working Paper (WP-2004-16). Unit for Social and Environmental Research, Chiang Mai University, Chiang Mai.

Lindbeck. A. 2008. European Social Model: Lessons for Developing Countries. DIANE Publishing, Jun 1, 2008 - 12 pages.

Lockwood, H. & S.Smits. 2012. Supporting Rural Water Supply - Moving towards a service delivery approach. Practical action Publishing. Accessed 2013-01-17. Available at: http://tinyurl.com/a6v33s2

Madu, C.N. and Kuei, C-H. (1995), Strategic Total Quality Management, Quorum Books, Westport, CT.

Madu, C.N. 1997. Quality management in developing economies. Internat. J. Quality Science, 2(4): 272-291.

Malam, N. 2010 ""Mieux Vaut Prévenir que Guérir": The Effect of Natural Disasters on Water- and Sanitation-Related Infectious Diseases and the Increasing Need for Disaster Preparedness". Independent Study Project (ISP) Collection. Paper 954. http://digitalcollections.sit.edu/isp_collection/954

Mara, D. and Evans, B. 2011. Sanitation & Water Supply in Low-income Countries. Ventus Publishing. Found online 2012-11-27 http://bookboon.com/en/textbooks/civil-engineering/sanitation-and-water-supply-in-low-income

Mara, D., Lane, J., Scott, B., Trouba, D. 2010. Sanitation and Health. PLoS Med 7(11).

Marin, P. et al. 2009. Public Private Partnerships for Urban Water Utilities: a review of experiences in developing countries. World Bank, Public Private Infrastructure Advisory Facility.

Markides, C. 1997. Strategic Innovation. Sloan Management Review 38(3):9-23

Matagi. S.V. 2002. Some issues of environmental concern in Kampala, The capital city of Uganda. Environmental Monitoring and Assessment 77:121–138.

Maxime, D., Marcotte, M. and Arcand, Y. 2006. J. Cleaner Production 14 (6–7):636–648.

Maynard, T. 2008. Climate Change: Impacts on Insurers and How They Can Help With Adaptation and Mitigation. In *Geneva Pap R I-Iss P* 33(1):140–146.

McGranahan G., Cyrus Njiru, Mike Albu, Mike Smith and Diana Mitlin, 2006, How Small Water
Enterprises can contribute to the Millennium Development Goals: Evidence from Dar es Salaam, Nairobi, Khartoum and Accra, Water, Engineering and Development Centre, Loughborough University, Leicestershire

Mehta, M. 2008. Assessing microfinance for water and sanitation, Exploring Opportunities for Sustainable Scaling Up. for the Bill & Melinda Gates Foundation. Final Report.

Meire, P., Ysebaert, T., van Damme, S., van den Bergh, E., Maris, T. and Struyg, E. (2005) 'The Scheldt estuary: a description of a changing ecosystem', Hydrobiologia, vol 540, nos 1–3, pp1–
11

Melo. J.C. 2005. The Experience of Condominial Water and Sewerage Systems in Brazil: Case Studies from Brasilia, Salvador and Parauapebas. August 2005. WSP-LAc The World BanK http://www.wsp.org/sites/wsp.org/files/publications/BrasilFinal2.pdf

Mills, E., Roth, J., Roth, J.R., Lecomte, E. 2005. Availability and Affordability of Insurance Under Climate Change: A Growing Challenge for the U.S. Available online at http://energy.lbl.gov/EA/emills/pubs/pdf/ceres-insur_report.pdf, updated on 29/11/2005, checked on 9/08/2012.

Moriarty, P., C. Batchelor, F. T. Abn-Alhadi, P. Laban, H. Fahmy. (2007) The Empowers approach to water governance, Guidelines, Methods and Tools. Inter-Islamic network on water resources development and management (INWRDAM).

Morshed, G. and Sobhan, A. 2010. The search for appropriate latrine solutions for flood-prone areas of Bangladesh. Waterlines 29(3).

Mosley, P. 2003. Risk and underdevelopment. Risk management options and their significance for poverty reduction. Report to DfID (R 7614).

Mostert, E., Pahl-Wostl, C., Rees, Y., Searle, B., Tàbara, D. and Tippett, J. 2007. Social learning in European river-basin management: barriers and fostering mechanisms from 10 river basins. Ecology and Society 12(1): 19

Neto, F. 2001. Alternative approaches to flood mitigation: a case study of Bangladesh. Natural Resources Forum 25 (2001) 285-297.

OECD. 2010. Dedicated Public-Private Partnership Units; A Survey of Institutional and Governance Structures, OECD, Paris

OECD. 2011 Cities and Green Growth: A Conceptual Framework. OECD Regional Development Working Papers, 2011, OECD Publishing, Paris

OECD. 2012. Roundtable of Mayors and Ministers. MOBILISING INVESTMENTS FOR URBAN SUSTAINABILITY, JOB CREATION AND RESILIENT GROWTH. 8 March 2012, Chicago, Illinois, United States. Issues Paper. http://www.oecd.org/gov/regionaldevelopment/49826482.pdf

Ofreneo. R.P. 2012. Addressing Social Dimensions of Climate Change through Adaptive Social Protection. In: Strengthening Social Protection Components and Strategies in the Philippines: A Compilation of Social Protection Think Papers. Department of Social Welfare and Development. United Nations Development Programme. National Economic and Development Authority

Olsen, S.I., Christensen, F.M., Hauschild, M., Pedersen, F., Larsen, H.F. and Törslöv, J. 2001. Life cycle impact assessment and risk assessment of chemicals — a methodological comparison. Environmental Impact Assessment Review 21:385-404.

Oxfam: Land and Power: The growing scandal surrounding the new wave of investments in land, 2011 http://www.oxfam.org/sites/www.oxfam.org/files/bp151- land- power- rights- acquisitions- 220911- en.pdf

Pahl-Wostl, C., Downing, T., Kabat, P., Magnuszewski, P., Meigh, J., Schuter, M., Sendzimir, J. and Werners, S. 2005. Transition to adaptive water management: The NeWater project. Osnabruck, Germany, Institute of Environmental Systems Research, University of Osnabruck, 19pp.(NeWater Working Paper 1, New approaches to adaptive water management under uncertainty)

Pahl-Wostl, C. Mostert, E. and Tàbara, D. 2008. The growing importance of social learning in water resources management and sustainability science. Ecology and Society 13(1):24. [online] http://www.ecologyandsociety.org/vol13/iss1/art24/

Pantelic. J., and Srdanovic, B. 2007. Sources of disaster vulnerability of the urban poor:issues and views. In: International Handbook of Urban Policy: Issues in the developing world. By H. S. Geyer. Edward Elgar Publishing. 310p.

Parkinson, J., Tayler, K. and Mark, O. 2007. Planning and design of urban drainage systems in informal settlements in developing countries. Urban Water Journal 4(3): 137-149.

Patterson, K. 2009. A Case for Integrating Groundwater and Surface Water Management in: Troubled Waters - Climate Change, Hydropolitics, and Transboundary Resources ed. David Michel and Amit Pandya (Stimson, 2009) http://www.stimson.org/images/uploads/research- pdfs/Troubled Waters- Chapter 5 Patterson.pdf

Patterson, M. 1998. Commensuration and Theories of Value in Ecological Economics. Ecol. Econ. 25(1):105-125

Petts J.(ed). 1999. Handbook of Environmental Impact Assessment, Volume 1. Blackwell Science, London.

Pinkerton, E. ed. 1989. Cooperative management of local fisheries: New directions for improved management and community development. Vancouver, Canada: University of British Columbia Press.

Rana. M. M. P. 2011. Urbanization and sustainability: challenges and strategies for sustainable urban development in Bangladesh. Environ Dev Sustain (2011) 13:237–256

Rashid, S. R. (2000). The urban poor in Dhaka city: Their struggles and coping strategies during the floods of 1998. Disasters, 20(3), 240–253.

Reed, M. S. Evely, A. Cundill, G. Fazey, I. Glass, J. Laing, A. Newig, J. Parrish, B. Prell, C. Raymond, C. and Stringer, L.C. (2010) What is social learning? Ecology and Society [online] www.ecologyandsociety.org/volXX/issYY/artZZ/

Tallis, H., Kareiva, P., Marvier, M. and Chang, A. (2008) 'An ecosystem services framework to support both practical conservation and economic development,' PNAS, vol 105, no 28, pp9457–9464

Task Forces (RTF) 1991. Report on Bangladesh Development Strategies for the 1990s – Environment Policy (Volume Four). Dhaka, University Press Limited, 265 pp.
Flood Control in Bangladesh through Best Management Practices. Md. Khalequzzaman http://www.lhup.edu/mkhalequ/research/floods-bd-bmps-ben.pdf

Rojas, A., P., and Rojas. J. 2010. The Aguade Flood Park: Recovering a post-industrial urban stream in santiago de Chile. http://www.holcimfoundation.org/portals/1/docs/F07/WK-Grn/F07/WK-Grn-.

Röling, N. and Wagemakers, A. (eds.). 1998. Facilitating Sustainable Agriculture. Participatory Learning and Adaptive Management in Times of Environmental Uncertainty, Cambridge University Press, Cambridge.

Sachs, J. D. (2001). Macroeconomics and health: Investing in health for economic development. Report of the Commission on Macroeconomics and Health, prepared for WHO

Sanctuary, M., Tropp, H. and Berntell, A. 2006. Making Water a part of economic development. The economic benefits of improved water management and services. Stockholm International Water Institute (SIWI), WHO.
http://www.who.int/water_sanitation_health/waterandmacroeconomics/en/index.html
(forthcoming in Dec 2012 in Earthscan)

Satterthwaite, D., S. Huq, M. Pelling, H. Reid and P. Romero Lankao. 2007. Adapting to Climate Change in Urban Areas, The possibilities and constraints in low- and middle-income nations. Working paper. Human Settlements Discussion Group Series. Theme 1: Climate Change and Cities. The International Institute for Environment and Development (IIED).

Schipper L, Pelling M. 2006. Disaster risk, climate change and international development: scope for, and challenges to, integration. Disasters 30:19–38.

Schlegelmilch, B.B., Diamantopoulos, A. and Kreuz, P. 2003. Strategic innovation: The construct, its drivers and its strategic outcomes. Journal of Strategic Marketing, 11: 117-132

Schusler, T. M., Decker, D.J. and Pfeffer, M.J. 2003. Social learning for collaborative natural resource management. *Society and Natural Resources* 15:309–326.

Schwartz, K. and Sanga. A. 2010. Partnerships between utilities and small-scale providers: Delegated management in Kisumu, Kenya. http://dx.doi.org/10.1016/j.pce.2010.07.003 Physics and Chemistry of the Earth, Parts A/B/C Volume 35, Issues 13–14, 2010, Pages 765–771

Schwartz, John. 2010 “In New Orleans, Ring of Protection is Close to Completion.” The New York Times. 23 August 2010. 4 November 2010. <http://www.nytimes.com/2010/08/24/us/24levee.html?_r=1>

Seed, R. et al. 2006 “Investigation of the Performance of the New Orleans Flood Protection System in Hurricane Katrina on August 29, 2005: Independent Levee Investigation Team: Final Report.” 2006. National Science Foundation. <http://Malam53digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1031&context=cenv_fac>.

Sharma, C.K., 1991, Energy and Environment in Nepal. Ambio, v. XX, no. 3-4, p. 120-123.

Silva, W., Dijkman, J.P. M. and Loucks, D.P. 2004. Flood management options for The Netherlands. Internat. J. River Basin Management 2(2):101-112.

Skees J., Hazell P., Miranda M. 1999. New Approaches to Crop Yield Insurance in Developing
Countries, IFPRI EPTD discussion paper no. 55, Washington D.C

Smaller, C. and Mann, H., 2009, A Thirst for Distant Lands: Foreign investment in Agricultural Land and Water, Winnipeg, IISD.

Smits, S.; Moriarty, P. and Sijbesma, C. (eds). 2007. Learning alliances: Scaling up innovations in water, sanitation and hygiene. Delft, The Netherlands, IRC. International Water and Sanitation Centre. (Technical paper series; no. 47). 174 p.

Stephenson D. 2002. Integrated floodplain management strategy for the Vaal (2002) Urban Water, 4 (4) , pp. 423-428.

Stevenson, G.G. 1989. The Production, Distribution, and Consumption of Fuelwood in Haiti. The Journal of Developing Areas. 24(1): 59-76.

Steyaert, P., Jiggins. J. 2007. Governance of complex environmental situations through social learning: a synthesis of SLIM’s lessons for research, policy and practice. Environmental Science & Policy 10:575 – 586.

Styles, C. and Goddard, J. 2004. Spinning the wheel of strategic innovation. Business Strategy Review 15(2): 63-72.

Sudmeier-Rieux, K., H. Masundire, A. Rizvi and S. Rietbergen (eds). 2006. Ecosystems, Livelihoods and Disasters: An integrated approach to disaster risk management. IUCN, Gland, Switzerland and Cambridge, UK. x + 58 Pp.

Sundaravadivel, M., Doeleman, J.A., Vigneswaran, S. 1999. Combined surface sewerage: a low-cost option for effective sanitation in semi-urban areas of India. Environ Engg and Policy No 1 (181-189). Found online 2012-11-28 http://www.personal.leeds.ac.uk/~cen6ddm/lowcostcombinedsewerage/CombinedSewerage_India.pdf

Surminksi, S., Oramas-Dorta, D. 2011. Building effective and sustainable risk transfer initiatives in low- and middle-income economies: what can we learn from existing insurance schemes? Center for Climate Change Economics and Policy (CCCEP) and Grantham Research Institute on Climate Change and the Environment (Policy paper), updated on 6/12/2011, checked on 9/08/2012.

Sutherland, A., da Silva Wells, C., Darteh, B. and Butterworth, J. 2012. Researchers as actors
in urban water governance? Perspectives on learning alliances as an innovative mechanism for change', Int. J. Water 6(3/4):311–329.

Syvitski. J.P.M. 2008. Deltas at risk. Sustainability Science.3(1): 23-32.

Tallis, H., Kareiva, P., Marvier, M. and Chang, A. (2008) 'An ecosystem services framework to support both practical conservation and economic development,' PNAS, vol 105, no 28, pp9457–9464

Tanzi, V., and Davoodi. H.R. 1997. Corruption, Public Investment, and Growth, Issue 97–139. International Monetary Fund. 23 pp.

Taylor, N. 2002. "Role and Design of Free Entry Policies: Expanding Service Options for Low-Income Households." Paper presented at the ADB/PIAF Conference on Infrastructure Development: Private Solutions for the Poor: The Asian Perspective, 30 October, Manila.

Ten Brink P., Mazza L., Badura T., Kettunen M. and Withana S. (2012) Nature and its Role in the Transition to a Green Economy. The Institute for European Environmental Policy (IEEP) Final Report

Thompson, G. 2004. Draft report "SANITATION PARTNERSHIPS IN MAPUTO, MOZAMBIQUE, A CASE STUDY. A shorter version is part of BPD SANITATION SERIES, Sanitation Partnerships: Maputo Case Study. http://www.bpd-waterandsanitation.org/web/w/www_40_en.aspx 2012-10-17 (accessed)

Tippett, J. Searle, B. Pahl-Wostl, C. and Rees, Y. (2005) Social learning in public participation in river basin management—early findings from HarmoniCOP European case studies. Environmental Science and Policy 8:287-299.

Trémolet S. and M. Rama 2012. Tracking national financial flows into sanitation, hygiene and drinking water. GLAAS working paper. WHO/HSE/WSH/12.05. Accessed online 2013-01-16. URL:
http://apps.who.int/iris/bitstream/10665/75225/1/WHO_HSE_WSH_12.05_eng.pdf

Tukker, A. 1999. Frames in the Toxicity Controversy. Kluwer Academic Press, Dordrecht.

Tyskeng, S. 2006. Environmental Assessments of Projects and Local Plans in the Energy and Waste Sectors in Sweden. PhD Thesis. Linköping University, Linköping, Sweden.

Twigg J. 2001. Corporate Social Responsibility and Disaster Reduction: a Global Overview, Benfield Greig Hazard Research Centre University College London. www.bghrc.com

Uganda Water and Sanitation NGO Network (UWASNET). 2012. NGOs in the Ugandan Water and Sanitation sector. Performance Report for FY 2011/2012.
http://www.uwasnet.org/Admin/pdf/REPORT_2011-12.pdf

United Nations. 1999. China bloods. OCHA Situation Report No. 10. UN/OCHA, Geneva

United Nations. 2006. Gender, water and sanitation case studies on best practices. Office of the Special Adviser on Gender Issues and Advancement of Women. Department of Economic and Social Affairs. Advanced version. Published online:
http://www.un.org/esa/sustdev/sdissues/water/casestudies_bestpractices.pdf

UNDP. Human Development Report. 2006. http://hdr.undp.org/en/media/HDR06-complete.pdf

UNEP. 2012. PSI. Principles for Sustainable Insurance. UNEP Finance Initiative. Available online at http://www.unepfi.org/fileadmin/documents/PSI_document-en.pdf, updated on 30/05/2012, checked on 24/07/2012.

UNESCO. 2012. 4th World Water Development Report 2012. Managing Water under Uncertainty and Risk.

UNESCO. 2006. Water, a shared responsibility. The 2nd UN World Water Development Report 2. UNESCO & Berghahn Books, NY. Accessed 2013-01-18. Available at:
http://unesdoc.unesco.org/images/0014/001454/145405E.pdf

UNISDR. 2002. Living with Risk: A global review of disaster reduction initiatives. Preliminary version, July 2002. http://www.unisdr.org/unisdr/Globalreport.htm

UNISDR. 2009. UNISDR terminology Accessed online:
http://www.unisdr.org/we/inform/terminology

UNISDR. 2012. How to Make Cities More Resilient - A Handbook for Local Government Leaders. Geneva. 99p.

U.S. House Select Bipartisan Committee to Investigate the Preparation for and Response to Hurricane Katrina. 2006. A Failure of Initiative. Washington, DC : U.S. Government Printing Office. http://katrina.house.gov/full_katrina_report.htm [accessed August 28 , 2006].

United States Agency for International Development (USAID) 2006. Enabling water services delivery for the urban poor in Asia. Best Practices review and workshop. USAID's Regional Environmental Cooperation-Asia (ECO-Asia) Program.

UWASANET. 2012. NGOs in the Ugandan Water and Sanitation Sector. Performance Report for FY 2011/12. Uganda Water and Sanitation NGO Network (UWASNET) Accessed 2013-01-18 at: http://uwasnet.org/Admin/pdf/2011-12_NGO_Report.pdf

Van Koppen, B. Smits, S. Moriarty, P. Penning de Vries, F. Mikhail, M. and Boelee, E. 2009 Climbing the water ladder: Multiple use water services for poverty reduction. The Hague: IRC International Water and Sanitation Centre.

Vermeiren J.C., 2000: Risk transfer and finance experience in the Caribbean, Managing Disaster
Risk in Emerging Economies. World Bank, Washington DC.

Warner, M., R. Sullivan. 2004. Putting Partnerships to Work: Strategic Alliances for Development Between Government, the Private Sector and Civil Society. Greenleaf Publishing, 2004 - 336 pp.

Waugh, W. L. and Streib, G. (2006), Collaboration and Leadership for Effective Emergency Management. Public Administration Review, 66: 131–140. doi: 10.1111/j.1540-6210.2006.00673.x

Wenger, E. 1999. Communities of Practice: Learning, Meaning, and Identity. Cambridge University Press. 336 pages

WHO. 2012. Research Priorities for Helminth Infections.WHO Technical Report Series 972. 174p.

WHO. 2008. The Global Burden of Disease: 2004 update. 146p.

Willetts, J, Pedi, D., Carrard, N., Powell, B. and De Lacy, I. 2008. NGO Partnerships and capacity development in the water, sanitation and hygiene sector. Prepared by the International Watercenter (IWC) and the Institute for sustainable futures (ISF), University of Technology Sydney. http://www.isf.uts.edu.au/publications/willettsetal2008ngowash.pdf

Wilson, F. 2012. A strategic Approach to Response and Recovery. http://bclc.uschamber.com/blog/2012-06-20/public-private-collaboration-six-years-after-hurricane-katrina In: The Role of Business in Disaster Response Report. Published by US Chamber of Commerce, Business Civic Leadership Center)

World Bank 2011. Innovation in Disaster Risk Financing for Developing Countries:Public and Private Contributions. http://www.ruralfinance.org/fileadmin/templates/rflc/documents/DRFI_WRC_Paper_FINAL_April11_pdf.pdf

Zeug, H. 2011. Analysis: Potential of microinsurance to sustain water and sanitation service. Report for Water for People.

Personal communication

Prakash Kumar, India
Manuel Alvarinho, CRA, Mozambique
Magnus Enell (Senior Advisor Vattenfall)
Björn von Euler (former ITT)
Wadström, Solvatten - at the Workshop: Resilience and DRR in WASH systems (water sanitation & hygiene) - Post disaster emergency & conflict situations, Co-Organised by the cluster group for water and DRR at SIWI + WASH & RESCUE research project (SEI), August 29th, 8.30 -12.30. Available at https://sites.google.com/site/waterdrr/resilient-wash

Websites

CDC website
http://www.cdc.gov/healthywater/wash_diseases.html
Duncan Mara website
http://www.personal.leeds.ac.uk/~cen6ddm/LowCostCombinedSewerage.html
DEWATS website http://www.borda-net.org/basic-needs-services/decentralized-wastewater-treatment.html
Sweden Green Building Council
www.sgbc.se
Projektet Hållbarhetscertifiering av stadsdelar
www.hallplatsen.nu
Guardian web http://www.guardian.co.uk/global-development/video/2012/nov/16/malloch-brown-weak-states-video
UNDP programme Public-Private Partnerships for Service Delivery (PPPSD).
http://www.undp.org/content/undp/en/home/ourwork/capacitybuilding/focus_areas/focus_area_details4/pppsd.html
World Bank, which through its Public-Private Partnerships in Infrastructure (PPPI) programme
http://wbi.worldbank.org/wbi/topic/public-private-partnerships