Climate Change Adaptation from an Urban Water, Sanitation and Hygiene Perspective: Insights from Dhaka

Lucy Faulkner

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Centre for Development and Emergency Practice (CENDEP)
School of the Built Environment
Oxford Brookes University
Abstract

The image on the front cover illustrates a snap shot of vulnerability to WASH (water, sanitation and hygiene) practice for low-income communities in Bangladesh’s capital city, Dhaka: young female inhabitants waiting at a ring well to collect insufficient water supply for daily needs that is contaminated by unhygienic flood water entering an illegal water pipe system at weak connection points. The potential impacts of climate change, characterised by greater temperature extremes, sea-level rise, increased frequency and intensity of cyclones and extreme precipitation events interspersed with longer dry periods leading to possible decreased surface water quantity and quality, decreased groundwater recharge, increased water demand, submersion of WASH infrastructure and increased competition for water resources, are set to exacerbate existing low-income community risk to WASH practice resulting in potential severe health issues. By assessing climate change risk through a social-vulnerability lens and within a context of high population growth and rapid urbanization, this dissertation emphasises the need to prioritise adaptation to WASH practice for the urban poor that challenges underlying social and political causes of vulnerability that lead to lack of access and equity in water and sanitation service provision, alongside climate-proofed technological investment, in order for sustainable climate smart development to be facilitated.

The cover image, and all photos presented in this dissertation, were taken by the author.
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Acronyms

BCCSAP - Bangladesh Climate Change Strategy and Action Plan
CARE – Christian Action Research and Education
CBO - Community Based Organisation
DCC – Dhaka City Corporation
DWASA - Dhaka Water Supply and Sewerage Authority
FGDs – Focus group discussions
GoB – Government of the People’s Republic of Bangladesh
ICDDR, B - International Centre for Diarrhoeal Disease Research, Bangladesh
IPCC - Intergovernmental Panel on Climate Change
MDGs - Millennium Development Goals
MODS - Maintenance Operations Development Services
NAPA - National Adaptation Programme of Action
NGO – Non-Governmental Organisation
PRA – Participatory Rapid Appraisal
RAJUK – Capital Development Authority or Rajdhani Unnayan Kotripakhkha
SIM – Social Intimidation Model
SRES – The Fourth IPCC Assessment Report’s six scenarios and storylines
UNFCCC - United Nations Framework Convention on Climate Change
WASH – Water, sanitation and hygiene
WatSan – Water and sanitation sector
WSUP – Water and Sanitation for the Urban Poor
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Chapter 1: Introduction
1. Introduction

“Whatever the bill is for safe water supply, we’re prepared to pay more.”
Shanu, 39, Housewife, Kalshibalur Math, Mirpur, Dhaka (10 August 2011)

1.1 The research idea
Adapting to the climate change - WASH - urban poverty nexus

Identified as one of the most vulnerable sectors to climate change impacts (IPCC, 2008), water resources are predicted to be the primary medium through which people, ecosystems and economies feel the early effects associated with climate change risk (Calow et al., 2011: 6). With global warming¹ expected to alter hydrological regimes and patterns of freshwater availability and quality (ibid), both surface and groundwater water sources are potentially threatened (UN-Water, 2010b).

In South Asia, climate change impacts are set to intensify present climatic and hydrological variability; wet areas will become wetter, dry and arid areas will become more so, and extreme hazard events, such as floods and tropical storms, are likely to increase in frequency and intensity (Calow et al., 2011: 44). For water availability, this means increased seasonal and higher intensity rainfall; increased seasonality of river flows; modification of groundwater recharge patterns and risk of significant reduction in the volume of reliable surface water resources (ibid: 7). In terms of water quality, potential widespread deterioration is expected with forms of water pollution exacerbated (IPCC, 2008), including salinity as sea-level rises (GoB, 2011) and pathogenic contaminant loading of shallow groundwater bodies due to the increased turbidity of surface water² (IPCC, 2008) from wet 5-day large-scale rainfall events (Howard and Bartram, 2010).

With existing drinking and domestic water sources likely to be compromised, those living in poverty in the most vulnerable developing countries with the least capacity to adapt (Ayers, 2010) and where progress on providing water services is most limited (Howard and Bartram, 2010) are set to

¹ Global warming refers to the gradual increase, observed or projected, in global average surface temperature, as one of the consequences of radiative forcing caused by anthropogenic emissions (IPCC, 2008). For a glossary of terms used in this dissertation, see Appendix 3.

² This means that increased precipitation intensity will lead to an increase in suspended solids (turbidity) that enhance the transport of pathogens and other dissolved pollutants (e.g., pesticides) to groundwater (IPCC, 2008).
be most affected by climate change impacts. Moreover, with hydrological linkages with sanitation and hygiene practices (WASH), potential reduced access to clean and adequate water supply presents an urgent health issue (WHO, 2008). Without clean drinking water human life cannot be sustained (CESCR, 2002), and without clean water effective sanitation and hygiene practices cannot be facilitated (Joshi, 2009) resulting in potential high levels of disease and mortality.

How global climate change impacts effects how access to local water resources is experienced is however determined by the local socio-economic and hydro-ecological characteristics of the exposed population (Orbicon, 2009a). Water security (encompassing issues of availability, quality, access and use) is not environmentally determined; it is a question of governance (WaterAid, 2010). Those most at risk from lack of access to safe WASH practice are not vulnerable by the potential hazard of climatic factors on WASH practice itself, but by the social factors that make people vulnerable to the hazard in the first place (Ayers, 2010: 77). Climate change does not produce effects in isolation of a broader set of factors (DFID/WHO, 2009); however it does add a new layer of risk intensifying existing water resource challenges for consumers and local service providers (Huq, personal communication, 3 July 2011).

For the one third of Dhaka’s 13 million inhabitants that live in low-income communities³ (Rabbani et al., 2011; BBS, 2011) in the capital of Bangladesh (figure 1.1 and 1.2 below), known for its extreme vulnerability to environmental risk (UN-HABITAT, 2008; Alam and Rabbani, 2007), access to safe WASH practice is already challenging without the additional implications of climate change. Paying more per litre than wealthier residents for illegal water connections that leave 30% of households experiencing acute water shortages on a daily basis (CBSG, 2010: 6); having inadequate water storage facilities (WaterAid, 2011b); lacking access to appropriate sanitation amenities (Joshi, 2011) where high population density means 82% of three or more households share unclean latrines (MoLGRD&C, 2011: 8) with many using unhygienic options (WSP, 2011); and an inability to secure personal sanitation and hygiene needs with dignity, privacy and security for women and adolescent girls, due to lack of access to safe water and sanitation facilities and gendered cultural formalities (ADG⁴ focus group, 11 August 2011).

Figure 1.1: Map of Bangladesh (MoLGRD&C, 2011).

³ By definition, a low-income community comprises of a minimum of 10 densely packed slum households (CBSG, 2010: 14).
⁴ ADG is an acronym for ‘adolescent girl.’
Figure 1.2: An administrative map of Dhaka (GIS Division, BCAS, 2011).
Moreover, as often located in low-lying parts of the mega-city\(^5\) with poor capacity sewage, drainage and illegal piped water systems (MoEF, 2005), 60% of informal settlements are prone to frequent flooding (UN-HABITAT, 2009) with inhabitants encountering faecal-water supply contamination leading to water- and sanitation-related disease\(^6\) (CBSG, 2010: 23).

“We don’t have any choice but to drink dirty water. God made a mistake in making slums and slum people.” Md. Joynal, Kalashibalur Math, Mirpur, Dhaka (8 August 2011)

Also, with poor hygiene practices facilitating the transmission of disease due to lack of knowledge and/or access to clean water supply, child mortality and malnutrition (WHO, 2008), reduced worker productivity (WSP, 2011), reduced attendance at school (WaterAid, 2011) and increased poverty levels (DFID, 2004) threaten livelihoods and the gross domestic product of Dhaka (Rabbani, personal communication 24 July 2011), as those living in informal settlements constitute the informal sector that serves its rich elite.

Furthermore, with rural-urban migration potentially posing the biggest challenge to Dhaka’s urban issues (Huq, personal communication, 3 August 2011), increasing migration, which may in part be due to direct and indirect climatic impacts happening elsewhere in Bangladesh (Hamza et al, 2010), is expected to intensify existing water and sanitation problems (Shaheen, personal communication, 8 August 2011).

As the fastest growing mega-city in the world even with declining fertility rates (UN, 2009), global drivers of change encapsulated by rural-urban migration, rapid urbanization, population growth and economic development are likely to pose bigger threats than climate change alone to future water supply and demand over the short-medium term (Calow, et al., 2011): the current water supply of DWASA, Dhaka’s Water Supply and Sewerage Authority, is already 35% below demand level (CBSG, 2010: 21).

“We are worried about more people coming. If legal connection, it will be ok. If illegal, our problems more.” Guria, 30, Handicrafts, Kurmitola Relief Camp, Mirpur, Dhaka (11 August 2011)

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\(^5\) Dhaka is known as a ‘mega-city’ because it is an urban area with a population of 10+ million inhabitants (Satterthwaite, 2011).

\(^6\) Water- and sanitation-related diseases include diarrhoea, cholera, dysentery, typhoid, malaria and intestinal worms (WHO, 2008).
Increased dependence on groundwater to meet future water demand is projected (Calow et al, 2011), yet Dhaka already experiences rapidly dwindling groundwater resources with current water supply being 87% dependent on it (Roy, personal communication, 9 August 2011). Besides, what groundwater does exist risks being contaminated by Dhaka’s polluted river water that is entering the sub-surface groundwater system due to unregulated excessive abstraction (NGO Forum, 2010a: 12).

Adding the potential future impacts of climate change to this scenario may further lower the efficacy of water supply and sanitation systems (DWC, no date), worsening access to safe WASH practice for low-income consumers (WaterAid, 2011b). Increasing temperatures (figure 1.3 below) further amplifying Dhaka’s heat island effect7 (GoB, 2011) and impacts of heat stress will hit informal sector worker productivity in heat-exposed jobs (Kjellstrom et al., 2009), children and the elderly hard due to possessing less coping capacity (IFRC, 2010). Unable to sufficiently counteract dehydration from inadequate water intake due to rising temperatures increasing water demand, informal settlement dwellers are likely to experience less access to water supply, hence being increasingly prone to heat exhaustion and heat stroke (Kjellstrom et al., 2009). Moreover, temperature rise will increase demand for industrial water for cooling systems, possibly aggravating conflict between domestic and industrial water supplies (GoB, 2011: 97; Orbicon 2009a, 2009b) resulting in again less potential access for low-income communities who are seen to further increase an already high demand supply gap (CBSG, 2010: 21).

Figure 1.3: Changing trend of average air temperature of Dhaka city from 1953 to 2010 (BCAS, 2011).

7 Heat island effect is caused by daytime heat being retained by the fabric of buildings and by a reduction in cooling vegetation (Kovats, 2010: 78). Moreover, heat island effect is likely to be further exacerbated by vehicle exhaust emissions, industrial activity and the increasing use of air conditioning by Dhaka’s wealthier residents (Alam and Rabbani, 2007), all of which show no signs of slowing down.
"The biggest problem is less water in summer. Health is worse in summer. Less hygiene practices happen and diarrhoea is worse as we eat rotten food."

Kohinur, 39, Housewife, Kalshibalur Math, Mirpur, Dhaka (10 August 2011)

Furthermore, diarrhoeal disease morbidity is likely to increase at higher temperatures (Kovats, 2009: 82), which low-income inhabitants are susceptible to with potential changing climatic circumstances. With probable lack of compensation due to ill-health in informal sector employment (Kjellstrom and Mercado, 2008), reduced income and increased expenditure for medical expenses may lead to increased debt initiating increased loans that potentially erode household sustainability (Pelling, 2011).

Likewise, disease vectors breed faster in warmer and wetter conditions and where there is poor drainage and sanitation (IPCC, 2008). Temperature increases mixed with projected increased precipitation events and possible initial glacier melt causing Dhaka’s surrounding rivers to spill over resulting in increased flooding (Alam and Rabbani, 2007) is likely to result in a rise in vector and water-borne diseases (Costello et al., 2009). Increased volumes of stagnant water from inadequate drainage will attract mosquitoes (Kovats, 2009) and over-flowing low-capacity sewage and drainage systems will increase faecal-water contamination and resultant disease (Hunter et al., 2010). Moreover, with poor sanitation infrastructure inundated, a rise in open defecation in open spaces and in open flood water surrounding local communities is plausible (NGO Forum, 2009), exacerbating water contamination and possible higher incidences of disease due to the unsafe disposal of human waste (UN, 2011). To avoid contact with surrounding polluted water, female inhabitants may be increasingly forced to stay inside their homesteads and undertake household activities as best as possible (FGD, 10 August 2011).

“Our life is very painful. I stay on my bed all day and cook as dirty water everywhere. I get scared as smoke gets in my eyes and I can’t see and large insects get on my clothes. Snakes sometimes come too.” Rahima, 50, Housewife, Kurmitola Relief Camp, Mirpur, Dhaka (10 August 2011)

With the inefficient burning of solid fuels on an indoor stove creating increased exposure to dangerous pollutants causing respiratory diseases, increased time and proximity to cooking fires potentially exacerbates the threat of disease from indoor air pollution (Kjellstrom and Mercado, 2008: 559). With acute illness being one of the main triggers driving people into extreme poverty in Bangladesh (MoEF, 2009) as low-income inhabitants “lose more and recover less” compared to wealthy counterparts, health is the upmost issue linking climate change impacts on water and
sanitation to informal settlement dwellers (Rabbani, personal communication, 24 July 2011).

The need to address potential climate change impacts on WASH practice for the urban poor is apparent. With all water security factors combined, an environment of future conflict over access to safe water sources may arise (ibid). With the impacts of climate change likely to place water and sanitation services at further risk (DfID/WHO, 2009), reaching target 7c of the Millennium Development Goals (MDGs), to halve the proportion of the population without sustainable access to safe drinking water and basic sanitation by 2015, looks out of further reach for the Government of the People’s Republic of Bangladesh (GoB) (GoB, 2009), despite access being a basic human right (UN, 2010) (Appendix 7).

1.1.1 Research inquiry

With possible substantial damaging effects on human health, urban livelihoods and the national economy, supporting low-income communities most at risk (Moser and Satterthwaite, 2008) with the impacts of short-term climate variability and extremes, and long-term climate change trends on WASH practice is needed (GoB, 2011). As relying solely on mitigation for water issues is not plausible (UN-Water, 2010), facilitating adaptation — preparing for and coping with climate impacts (Swalheim and Dodman, 2008) — is key (IPCC, 2007).

While all of Dhaka’s residents may be hit by the same climatic impacts on WASH practice, its low-income inhabitants will almost certainly be disproportionately affected due to the double vulnerability of climate change and poverty (Allen et al, 2010). Poverty makes people more vulnerable to climate change risk (Bartlett et al., 2009) and vulnerable people have a lack of access to resources required to cope with the extra burden brought by this risk (Oxfam, 2009). Vulnerability to climate change impacts on WASH practice for low-income inhabitants is therefore increasingly the result of local government failures that limit the resources available that are needed for effective adaptation (Huq and Satterthwaite, 2008: 2).

Despite a certain level of ‘built-in resilience’ (Jabeen et al., 2010), low-income inhabitants are highly

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8 Latest statistics state that 80% of Bangladesh’s population has access to clean drinking water and 54% has access to improved sanitation (JMP, 2010). These figures are however viewed with skepticism (NGO Forum, 2010; WaterAid, 2010). Moreover, as target 7c underpins MDG1 (poverty), MDG2 (education), MDG3 (gender equality), MDG4 (reduction in child mortality) and MDG 7d (significantly improving the lives of at least 100 million slum dwellers), its importance is apparent (Hunter et al., 2010).
dependent on local institutions that enable access to assets they require to help them build their ‘adaptive capacity’ (Ayers, 2010: 228) - the inherent or existing ability of a community, institution or country to cope with climate impacts (Huq and Reid, 2009: 315 cited in ibid). With existing development deficits characterised in part by lack of access to safe water and sanitation services contributing to low-income inhabitant risk, improving and extending access to sustainable and affordable water and sanitation services remains key to reducing health inequalities (Kjellstrom and Mercado, 2008: 563) and strengthening the adaptive capacity of informal settlement inhabitants to climate change impacts on WASH practice (Calow et al., 2011; UNDP, 2011).

However, facilitating improvement and access is often problematic due to the ineffectiveness of institutions mandated to manage water and sanitation facilities (Hunter et al., 2010). Granting access may largely be dependent on changes in attitude and approach by local government agencies (Satterthwaite et al., 2005: 21) that may inhibit access due to viewing the urban poor as illegal citizens outside of their remit (Swalheim and Dodman, 2008: 2). Underlying social and political factors embodied in land tenure insecurity and threat of forced eviction offer little incentive to invest in low-income settlements that are seen to not be commercially viable (CBSG, 2010). Moreover, limited capacity to facilitate pro-poor service provision may also inhibit access. Possible institutional barriers, operational malpractice and inadequate financial and human resources leave many low-income consumers no option but to resort to illegal water connections (ibid: 28). Identifying what support is needed to overcome these constraints and inadequacies – the ‘adaptation gap’ - is needed if pro-poor service delivery is to be facilitated.

Reducing risk to climatic impacts on WASH practice for informal settlement inhabitants will therefore primarily be achieved through ‘good governance’ and appropriate funding flows (Satterthwaite et al., 2008: 33). A pro-poor adaptation strategy is likely to be assisted through improved institutional competence, capacity and accountability, as these attributes almost by definition increase adaptation capacity and increase the possibilities of service provision being ‘pro-poor’ (ibid: 59). Moreover, a pro-poor adaptation strategy demands that city governments see low-income inhabitants as active participants in identifying and helping implement solutions to the challenge of climate change (Swalheim and Dodman, 2008: 2). To this means, forging long-term partnerships that ensure inclusiveness and accountability between local government, community organisations and the urban poor themselves is essential if the climate change context is to be used as an opportunity.

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9 ‘Sustainable’ development is a combination of two goals: meeting the needs of the present without compromising the ability of future generations to meet their needs (Satterthwaite, 2011: 1765).
for change that challenges development inequalities and failures rather than further entrenching them (Pelling, 2011: 126).

To build the adaptive capacity of low-income inhabitants to potential future climate change impacts on WASH practice therefore, enabling adaptation strategies that address climatic and non-climatic risk factors is needed. This means paying attention to and addressing the factors that undermine their ‘adaptation deficit’ - the existing capacity to cope with and adapt to current climate variability risks (Burton, 2004 cited in ibid: 84). By understanding the local context of vulnerability and the present WASH practice of Dhaka’s informal settlement dwellers, insight into how to empower those most vulnerable to cope with and adapt to potential future climate change impacts can be sought. Adaptation strategies aimed at reducing the ‘adaptation deficit’ is needed before adaptation to future climate change can occur (ibid).

Effective adaptation to WASH practice therefore requires a multi-layered technological, social, cultural and political process, as risk from environmental change is largely a product of social amplification (Pelling, 2011: 16). Building adaptive capacity requires actions that focus on the measurable and verifiable impacts of climate change and on a wider range of factors that contribute to a broader reduction in vulnerability to climate variability and climate change impacts (Ayers 2009: 231). Climate-proofing technological water and sanitation investment is not enough if adaptation is to facilitate sustainable climate smart development (Rahman, personal communication, 18 August 2011), as for those living in urban poverty water security is rooted in the institutional politics of urban governance structures. Changes in values and associated governance regimes need to be on the adaptation agenda if moving beyond coping with and adapting to the ‘symptoms’ of climate risk to addressing its underlying ‘root causes’ is to be facilitated (Pelling, 2011: 16).

1.1.2 Research question
This gives rise to the following:

1. What is the WASH practice of low-income inhabitants in Dhaka in the current context of climate variability? What risks are perceived to exist? What is the existing capacity to cope with and adapt to these risks?
2. What support is required to build low-income inhabitants’ adaptive capacity to climate variability and climate change impacts on WASH practice?

3. What issues and constraints limit the ability of mandated service providers to supply basic service provision to low-income inhabitants and what support is required to address these issues?

1.2 Aim and objectives

1.2.1 Research aim
To present recommendations on building the adaptive capacity of low-income inhabitants in Dhaka to the potential effects of climate change on WASH practice.

1.2.2 Research objectives
1. To explore WASH practice and its implications on health and livelihoods of low-income inhabitants in Dhaka in the current context of climate variability.

2. To assess how to reduce the adaptation deficit (the existing capacity to cope with and adapt to current climate variability risks) of low-income inhabitants in Dhaka to WASH practice and to provide findings on how to build adaptive capacity to future climate change.

3. To determine the adaptation gap of local WASH institutions in Dhaka and to provide findings of how pro-poor adaptation to WASH practice can be facilitated.

1.3 Relevance and significance of the research
The importance of focusing on water and sanitation is evident: “Safe drinking water and adequate sanitation are crucial for poverty reduction, crucial for sustainable development, and crucial for achieving any and every one of the MDGs.”\textsuperscript{10} The same is true of climate change, which is believed to be the crucial issue of the 21\textsuperscript{st} century (UNDP, 2007) that poses the greatest threat to poverty reduction (Christian Aid, 2006). Moreover, for the first time in history more people live in urban than rural areas (Satterthwaite, 2011), with the majority of the world’s urban population living in low and middle income countries in some of the world’s largest cities where the need to look at the challenges and risks faced in these areas due to climate change is stated (Huq and Satterthwaite, 2010).

\textsuperscript{10} Excerpt from former Secretary-General of the United Nations, Ban Ki Moon’s speech on World Water Day, 2007.
Therefore, with the irreversible trends of rapid urbanization and climate change (Guterres, 2010), the growing inequities between the urban rich and poor (World Bank, 2005), and the increasing health and subsequent economic risks to individuals, households and cities themselves due to a lack of access to safe water and sanitation services (WSP, 2011), the need for research on how climate change impacts will affect WASH practice for those living in urban poverty is needed.

How climate variability and future climate change impacts will affect the sustainability of WASH practice is emerging as a new topic of enquiry in Bangladesh (WaterAid, 2011a). A substantial rural bias is however evident. The majority of research to date on climate change impacts on WASH, which is limited, and indeed on climate change impacts on poverty, which is more extensive, have seen significant attention been given to the rural context (Allen et al, 2010), hence the need for research on the impacts of climate change on WASH and subsequent impacts on the livelihoods of the urban poor has been voiced (Banks et al, 2011; Roy et al, 2011). This need is considerable as the tipping point at which the number of urban poor will exceed the number of rural poor is set to happen within this generation (Roy, 2011).

1.4 Research scope
This study therefore focuses on the current impacts of climate variability on WASH practice for a sample of urban respondents residing in two informal settlements in Dhaka; to assess existing WASH practice in order to identify how future impacts of climate change associated risk might affect the urban WASH and livelihoods system, and to investigate how adaptation can be strengthened by exploring potential options for building the adaptive capacity of households and local institutional WASH structures.

1.5 Methodology and research design

11 The need for research on the potential future impacts of climate change on WASH was voiced in person by the directors and associate researchers at BCAS, and research and programme managers at NGO’s CARE-Bangladesh and WaterAid Bangladesh.
1.5.1 Research design

This exploratory social research follows an interpretativist philosophy; one which focuses on studying phenomena in their natural environment in order to gauge reality (Walliman, 2006) as understanding contemporary events is required in order to answer this dissertation’s research inquiry. An inductive, primarily qualitative approach is therefore used, as it is an investigation that seeks to understand unfamiliar territory for the author in terms of focus and location. Consequently, a hypothesis that tests a pre-determined theory is not presented. As effective adaptation depends on understanding the local context of vulnerability (Ayers, 2010), a descriptive survey approach is used to gain knowledge from respondents in a participatory fashion (Chambers, 1997) to acquire insight on the chosen study topic.

The context of Dhaka and its low-income inhabitants is selected due to the geographic positioning of Dhaka in one of the world’s most vulnerable countries to climate change impacts; its low-income inhabitants being most vulnerable to climatic impacts, and the gap in research focusing on climate change impacts on WASH and in Dhaka itself. The rise in urban poverty in Dhaka and its potential increase due to future rural-urban migration and population rise incited the author’s personal decision to focus on the topic through an urban lens. This decision was complimented with logistic ease of being given access to respondents via an existing urban project courtesy of NGO’s WSUP, Water & Sanitation for the Urban Poor, and CARE Bangladesh (Appendix 4).

1.5.2 Research strategy and methods of data collection

To achieve the aim of this dissertation mixed methods of data collection were employed, using qualitative and quantitative research, and the collection of primary and secondary evidence.

1.5.2.1 Primary data

Primary data was collected as a result of fieldwork undertaken by the author in Dhaka, Bangladesh from June 26 to August 22, 2011. Data collection methods comprised of semi-structured interviews, household questionnaires, focus group discussions (FGDs), participant observation, key informant interviews, an institutional mapping Participatory Rapid Appraisal (PRA) tool and field notes. The household questionnaire (Appendix 5) was undertaken by 50 households selected on availability for interview at the time fieldwork was being undertaken from two informal settlement sites in Mirpur, Dhaka - Kalsibalur Math (east side) and Kurmitola Relief Camp. The purpose of the household questionnaire was to understand respondents’ socio-economic profile including their WASH status;
respondent perceptions of climatic and non-climatic risk; strategies undertaken to cope with and adapt to the above risks; existing local institutional linkages,\textsuperscript{12} and respondent perceptions of support required to build adaptive capacity. Questions asked were framed using language understood by respondents. Constant monitoring ensured equal numbers of male and female respondents completed the household questionnaire with each well-being ranking category represented: extreme poor, ultra poor, poor and lower middle class (Appendix 1). As these well-being groupings were determined by respondents themselves in response to previous fieldwork undertaken by the CARE Bangladesh field team used by the author, they were used as a guide to ensure households considered most vulnerable in each field site were included in the research.

Three FGDs were conducted, one for each of sector of the community relevant to the focus of this dissertation: men, women and adolescent girls (Appendix 9). FGD participants represented inhabitants from both field sites. Building on household questionnaire findings, an institutional mapping exercise was undertaken with a group of separate men and women from both field sites, in order to gauge the degree and type of access respondents’ have to local institutions (Agrawal, 2010). Instruction on how to undertake this tool was given by the author to members of the CARE Bangladesh field team, as it was unfamiliar. 22 key informant interviews were conducted in person in Dhaka with NGO staff, academics, researchers and GoB officials to ascertain key issues and recommendations to improve facilitation of pro-poor adaptation to WASH practice (Appendix 2). Research validity was ensured for all data collection methods through the triangulation of sources.

(From left to right): male institutional mapping (10 August); completing household questionnaires with CARE Bangladesh field team (4 August); women’s FGD (10 August).

\textbf{1.5.2.2 Secondary data}

\textsuperscript{12} Local institutions refers to any formal or informal institution that enables vulnerable groups to gain access to assets they require to help them build their adaptive capacity (Ayers 2010: 228).
Secondary data was appraised in order to present an in depth literary portrayal of the current understanding of the chosen study topic. State-of-the-art peer review journal articles, grey literature and policy documents from NGOs and government have been explored in order to convey a thorough background upon which fieldwork research findings can be contextualised.

1.6 Analytical framework
This dissertation uses a new framework encapsulating the underlying social root causes of human vulnerability to climate risk (Pelling, 2011). Seeing adaptation to climate change as a social, cultural, political and technological process (ibid: 19), three adaptation pathways - resilience, transition and transformation – are presented as a means to assess which level adaptation can intervene in development based on the degree of social and political change the adaptive action informs.

![Figure 1.4: The resilience-transition-transformation framework (Pelling, 2011: 23).](image)

Based on Pelling’s adaptation framework (figure 1.4 above), if a slum household\(^{13}\) (UN-HABITAT, 2006) is exposed and susceptible to a perceived risk, such as increased threat of diarrhoeal disease due to flooding intensifying existing unsafe WASH practice, then a hazard occurs causing risk. Adaptation encapsulates the response to this risk. Looking at adaptation from a social-vulnerability

\(^{13}\) A ‘slum household’ is defined as one that lacks access to improved water and sanitation services, tenure security, durability of housing, and sufficient living area (UN-HABITAT, 2006).
perspective rather than an impacts-based approach,\(^{14}\) if no adaptation is undertaken to tackle the social root causes of this vulnerability, then the slum household’s vulnerability to this risk remains unchallenged with susceptibility to climate change risk likely to be exacerbated (Pelling, 2011: 23).

If adaptation does occur, it can manifest as resilience (stability); transition (small incremental social change), or transformation (complete political regime change) (table 1.1 below). Nevertheless, building resilience can lead to increased risk exposure if incremental adjustments offset immediate risks while the larger system moves closer towards a tipping point of collapse (ibid). As adaptation can therefore foster development or create conditions for climate change risk,\(^{15}\) it is placed in a pivotal role in the coproduction of risk and development (ibid). Climate change risk is seen as a product and driver of development rather than as an external threat to it (ibid: 164).

<table>
<thead>
<tr>
<th></th>
<th>Resilience</th>
<th>Transition</th>
<th>Transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goal</strong></td>
<td>Functional persistence in a changing environment</td>
<td>Realise full potential through the exercise of rights within the established regime</td>
<td>Reconfigure the structures of development</td>
</tr>
<tr>
<td><strong>Scope</strong></td>
<td>Change in technology, management practice and organisation</td>
<td>Changes in practices of governance to secure procedural justice; this can in turn lead to incremental change in the governance system</td>
<td>Change overarching political-economy regime</td>
</tr>
<tr>
<td><strong>Policy focus</strong></td>
<td>Resilient building practices; use of new seed varieties</td>
<td>Implementation of legal responsibilities by private and public sector actors and exercise of legal rights by citizens</td>
<td>New political discourses redefine the basis for distributing security and opportunity in society and social-ecological relationships</td>
</tr>
</tbody>
</table>

Table 1.1: Attributes of adaptation for resilience, transition and transformation (Pelling, 2011: 51)

This framework has been chosen as a guide upon which to analyse research findings for this dissertation as it offers a novel way to explore data collected in order to assess how to build the

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\(^{14}\) A social-vulnerability based perspective on climate change risk shifts the emphasis of risk assessment away from climate change impacts (impacts-based approach) and towards the local circumstances of vulnerability (Ayers, 2010: 17). Many proponents of a social-vulnerability approach to adaptation argue that impacts-based risk assessments and resulting adaptation measures can only be partially effective if they do not also address non-climatic factors that drive the underlying causes of vulnerability (ibid).

\(^{15}\) Adaptation strategies that enhance conditions for climate change risk is also known as ‘maladaptation’: actions or investments that increase rather than reduce vulnerability to climate change impacts (Ayers, 2009: 232; Satterthwaite et al., 2008).
adaptive capacity of respondents. It offers a platform to discuss: what constitutes resilience, transition and transformation on the ground?

1.7 Research challenges

The short time between confirming the topic of the study and undertaking fieldwork proved challenging for the author due to the focus on WASH being a brand new area of interest in addition to undertaking research in a country and urban context never experienced before. The research topic was decided on after a series of consultation meetings upon the author’s arrival in Dhaka, which highlighted the need for research in this study’s chosen subject area.

A big challenge to the research was that the author did not speak Bengali. Basic introductions were learnt in advance of starting fieldwork, however complete reliance on translation of respondent information from the CARE Bangladesh field team was depended upon during data collection of household questionnaires and FGDs. This presented challenges based on the disparity in English proficiency within the field team. Interpretation of FGDs was secured by having access to a confident translator from the NGO CARE Bangladesh. All key informant respondents spoke excellent English so no translator was required, except for one interview where assistance from the above translator was provided. Possible interpretation of questions and therefore answers due to language differences was however acknowledged for all respondents.

Fieldwork was undertaken during Ramadan meaning time available for data collection was confined due to a change in working hours, with awareness of the field team working in periods of intense heat without the ability to keep hydrated during daylight hours being strongly acknowledged. Furthermore, equal numbers of household questionnaires from each well-being category were not ascertained as planned due to the availability of different households for interview in light of their working hours coupled with the working hours of the field team during Ramadan. Equally, fieldwork was undertaken during the monsoon season meaning access to respondents was problematic on occasion due to roads being flooded due to heavy rainfall, making transportation difficult.

1.8 Ethical considerations

False expectations of research outcomes were addressed by voicing clear intentions and conditions under which the study was to be administered to respondents before fieldwork began. The right to
not participate was adhered to, and for those that chose to contribute to this inquiry, time kindly given was subject to respondents discretion to ensure livelihood and household activities were respected. To reduce the cost of FGD participation tea and snacks were provided, and all photographs were taken with permission.

1.9 Structure of the study

Chapter 1: An introduction presenting how potential climate change impacts may exacerbate existing risk to WASH practice for Dhaka’s informal settlement inhabitants is given. The research inquiry follows, outlining adaptation as a response to this scenario with possible constraints in facilitating pro-poor adaptation to WASH practice presented. With social and political factors underpinning lack of access to basic service provision, an argument that WASH adaptation needs to move beyond addressing ‘symptoms’ of climatic impacts to addressing social and political ‘root causes’ is made. Next, the research question, aim, objectives and justification are given. A section discussing research methodology and research challenges, and a presentation of this dissertation’s chosen analytical framework is also found in this chapter.

Chapter 2: A series of background issues relating to the research idea are given. Topics covered include WASH, how climate change impacts are set to affect water resources and specifically water resources in Dhaka, and hence what adaptation challenges face DWASA, Dhaka’s water supply and sanitation utility, who is responsible for providing informal settlement inhabitants with water supply. A section framing approaches to planning adaptation and what constitutes adaptive capacity is also presented.

Chapter 3: Background information on the two informal settlement field sites in Dhaka where research was undertaken by the author is given to provide context for fieldwork findings. Data collected is then presented, illustrating the current WASH practice of respondents in a context of climate variability. Local perceptions of climatic and non-climatic risk to WASH practice; autonomous adaptation strategies utilised; and respondent perceptions of support required to strengthen their ability to cope with and adapt to climatic impacts on WASH practice are outlined. Issues and recommendations gathered from key informant interviews on how to facilitate pro-poor adaptation to WASH practice for respondents are also presented.

Chapter 4: Building on the previous chapter, the ‘adaptation deficit’ of respondents is assessed. An analysis of how the WSUP project in operation at the time of research contributed to reducing this
deficit is presented, using Pelling’s resilience-transition-transformation framework as a guide for discussion. Similarly, once assessed, how to address the adaptation gap of DWASA in order to facilitate pro-poor service delivery is presented. Further adaptation needs required to build the adaptive capacity of respondents to climate variability and climate change impacts on WASH practice that go beyond the scope of the WSUP project across community, municipal and national level are discussed.

Chapter 5: Recommendations suggesting how to build the adaptive capacity of respondents to future climate change impacts on WASH practice at community, municipal and national level are presented.
Chapter 2: Background
2. Background

“With the severe potential health impacts on low-income communities due to climate change risk on WASH practice, water and sanitation is the entry point for looking at climate change in urban areas.”

Dr. Atiq Rahman, Executive Director, Bangladesh Centre for Advanced Studies, Dhaka (18 August 2011)

2.1 Unpacking WASH

Basic needs of safe drinking water, sanitation and hygiene practices are fundamental to public health and development (WHO/DfID, 2010). For the majority of Dhaka’s inhabitants living in low-income communities however, lack of access to an ‘improved drinking water source’ protected from outside contamination, especially with faecal matter (WHO/UNICEF, 2010: 34), and to ‘improved sanitation facilities’ that hygienically separates human excreta from human contact is rife (ibid) (figure 2.1 below).

Figure 2.1: WHO/UNICEF Joint Monitoring Programme (JMP) indicators used to define access to basic sanitation and safe drinking water to calculate MDG target 7c (WHO/UNICEF, 2010: 34). For definitions of these indicators, see Appendix 6.

With one gram of human faeces containing around 10,000,000 viruses, 1,000,000 bacteria, 1,000 parasite cysts and 100 parasite eggs (WaterAid, 2010b), exposure can quickly spread diarrhoea and non-diarrhoeal disease through a community (WaterAid, 2011). As ingesting human faeces is possible through the five pathways of the faecal-oral transmission route (fluids/water; fingers; flies; food; and field), the safe disposal of excreta combined with improved hygiene practices are essential

16 Exact figures are not available.
barriers in preventing disease transmission (figure 2.2 below) (TdH, 2009: 7): water-related diseases are responsible for 24% of all deaths in Bangladesh,\(^{17}\) with diarrhoea being the second leading cause of morbidity and the fourth leading cause of death among children (WSP, 2011).

Figure 2.2: The faecal-oral transmission routes (TdH, 2009: 7).

To gain the full benefits of safe water and sanitation, awareness of the linkages between disease and unsafe hygiene practices is needed (WaterAid, 2011). Administering good hygiene with the provision of safe water and sanitation facilities reduces mortality caused by diarrhoeal diseases by an average of 65% (ibid). Hand-washing with soap and water alone can reduce diarrhoeal diseases by up to 47% by preventing the transmission of pathogens that cause ill-health (UN- Water, no date), making it a better option for disease prevention than any single vaccine or hygiene behaviour (WSP, no date: 5).

\(^{17}\) Source: WaterAid Bangladesh: http://www.wateraid.org/uk/what_we_do/where_we_work/bangladesh/
With inadequate sanitation believed to cost an economic loss of US$29.6 per person each year in Bangladesh (WSP, 2011), practicing safe WASH practice can cultivate numerous socio-economic benefits (figure 2.3 below).

**Figure 2.3**: Expected economic impacts of using safer sanitation and hygiene options in Bangladesh (WSP, 2011: 1).

### 2.2 Understanding climate change

It is unequivocally confirmed that climate change is due to global warming as a result of increase in concentration of greenhouse gases (GHG) caused by natural variability and human activity (IPCC, 2007) of burning fossil fuels and changes in land use since the beginning of the European industrial revolution (The Royal Society, 2010). Multiple changes to global systems have resulted; increases of more than 0.6°C in average global temperature; changes in cloud cover and precipitation, particularly over land;\(^{18}\) melting of ice caps and glaciers and reduced snow cover;\(^{19}\) global average sea-level rise\(^{20}\) and increases in frequency and intensity of extreme weather events (figure 2.4 below) (IPCC, 2007).

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\(^{18}\) Increased precipitation has been observed across parts of North and South America, northern Europe and northern and central Asia, while declining in the Sahel, Mediterranean, southern Africa and parts of southern Asia (IPCC, 2007).

\(^{19}\) The average annual Arctic sea ice extent reducing by 2.7% per decade (IPCC, 2007).

\(^{20}\) Sea levels are rising by 3.1mm/yr since 1993 compared to the average rate of 1.8mm/yr since 1961 (IPCC, 2007).
What this implies for 21\textsuperscript{st} century humanity is largely uncertain; the best estimate on globally averaged temperature indicates a rise between 1.8\degree C and 4\degree C by 2100 (IPCC, 2007).\textsuperscript{21} Although exact effects of the IPCC’s AR4 SRES scenarios\textsuperscript{22} are now viewed as conservative with major uncertainties remaining, climate change is set to intensify present climatic variability rather than represent a catastrophic change in mean climate state (Calow et al., 2011: 3).

\textbf{2.3 Climate change and water resources}

\textsuperscript{21} Some estimates state as high as 7.1\degree C based on different scenarios (The Royal Society, 2010).

\textsuperscript{22} To understand potential climate change impacts, the IPCC has developed a range of scenarios in the Fourth Assessment Report (known as SRES scenarios) based on different assumptions of the main demographic, economic and technological driving forces of emissions within different possible pathways of global socio-economic development (Calow et al., 2011: 1).
Global mean temperature rise has intensified the existing global hydrological system as a result of climate change. Likely impacts include (figure 2.5 below) (IPCC, 2008: 3):

- Increased atmospheric water vapour content;
- Changes in precipitation including greater variability, intensity and extremes;
- Reduced snow cover and widespread melting of ice;
- Changes in glacier melt contribution to downstream run-off;
- Changes in streamflow timing through the year;
- Changes in soil moisture;
- Increased frequency and intensity of extreme high and low events, and
- Potential widespread deterioration in water quality with many forms of water pollution exacerbated, such as salt, pathogens and pesticides.

These impacts are likely to mean (IPCC, 2008):
- Increased flood and drought risk
- Deterioration in surface water availability and quality
- Irregular groundwater recharge patterns
- Changes in food availability, stability, access and utilization due to changes in water quantity and quality
- Function and operation of existing water infrastructure and management practices affected

2.4 Climate change, water resources and Dhaka

Dhaka is recognised for its extreme vulnerability to climate change impacts (Rabbani et al., 2011; UN-HABITAT, 2009), which is in part due to its centrally located low-lying coastal location within Bangladesh. Bangladesh, a flat low-lying country in the middle of one of the world’s largest mega-deltas, the Ganges-Brahmaputra plain in the Bay of Bengal (figure 1.1), is one of the countries most at risk to climate change (Raihan et al., 2010) due to the following biophysical and social vulnerability factors (Ayers, 2010: 120): unique geographical location, low elevation from the sea, high frequency of natural hazards, reliance on flood-and drought-prone agricultural land, high population density, acute poverty levels and weak economy (Maplecroft, 2010; Dwirahmadi, 2010).

In terms of climate, Dhaka has high temperatures and humidity (an annual average of 25°C), particularly during the dry season from March to May, and heavy rainfall (an annual average of 2,000mm) during monsoon from June to October (Rabbani et al., 2011: 531). Surrounded by rivers on all sides, Dhaka experiences flooding approximately once every five years due to overflow (ibid) combined with internal water-logging problems (Alam and Rabbani, 2007) due to existing poor capacity drainage systems and unplanned concrete development. Dhaka’s unprecedented rate of growth in area and population since gaining independence from Pakistan in 1971 (ibid: 82) has resulted in increasing economic divide and high levels of poverty (Taher and Islam, 2009), with a comprehensive policy on urbanization and attention to adaptation insufficient (World Bank, 2005).

Rapid rates of in-migration, estimated at 400,000 new migrants every year (World Bank, 2005), add strain to an already over-crowded mega-city distinguished by its development deficit that generates climate change risk for its low-income inhabitants (Bartlett, 2009): large amounts of poor housing on hazardous land due to limited space; excessively high land prices pricing those in poverty out of the market; water shortages; poor sanitation and drainage; increasing air pollution; irregular electric
supply; regular discrimination and poor urban governance (Zetter and Deikun, 2010; Sanderson 2005). Inequality and uneven power relationships extend beyond access to basic services, robbing residents of their rights to their city (Allen et al., 2010).

In terms of water resources, Dhaka experiences a scarcity and abundance of water; too little in the dry season and too much during monsoon (BCAS/NGO Forum, 2010). Up-stream flow decreases and groundwater levels deplete in the dry season. During monsoon, floods due to heavy rainfall are commonplace exacerbating surface and groundwater water source pollution (ibid). Moreover, water has evolved from being a common good into an economic one; over extraction for industry and consumption is commonplace due to population growth, economic development and rapid urbanization (ibid). Furthermore, the rich elite control most water resources, with poor and marginal groups unable to meet their basic needs (ibid).

This scenario is likely to be exacerbated by the following potential climate change impacts (Rabbani et al., 2011: 536-7):

- **Greater temperature extremes**: Temperatures projected to increase during monsoon by 0.7°C and by 1.3°C in winter leading to climate induced heat and cold waves.
- **Increased rainfall variation**: Overall average annual rainfall is not set to change significantly, however the number of days without rainfall is increasing and sporadic heavy rainfall events are becoming more frequent.
- **Flooding and water-logging**: Dhaka is already vulnerable to flooding and water-logging risk due to its geographic location and poor urban management. Current flood protection investments predominately serve only a portion of the city’s population and businesses (Alam and Rabbani, 2007). Moreover, inadequate facilities for pumping water from inside the existing flood embankment contributes to increased flood risk (Alam, 2008).
- **Cyclones and storm surges**: Dhaka is vulnerable to cyclonic wind, which when coupled with increased rainfall presents water-logging and infrastructure damage risk.
- **Sea-level rise**: Potential indications vary from 30-50 cm between 2030 and 2050 (World Bank, 2000). Elevated between 2-13 m above sea level, these indications pose serious risk for Dhaka (Rabbani et al., 2011).

As depicted in Chapter 1, these potential climatic impacts are likely to affect Dhaka’s water and
sanitation sector, and its low-income inhabitants who are most at risk from these impacts on WASH practice, through the following means:

Figure 2.6: Potential climate change impacts on Dhaka’s water and sanitation sector (GoB, 2011: 98 and adapted by the author).
As a result, DWASA, Dhaka Water Supply and Sewerage Authority - the GoB agency mandated to provide water supply, sewerage and storm water drainage services to all Dhaka’s inhabitants, including low-income communities, through 10 Maintenance Operations Development Services (MODS) Zones (one in each of the mega-city’s 10 zones) in line with GoB poverty reduction policy\textsuperscript{23} (CBSG, 2010: 13) - faces substantial adaptation challenges given its existing circumstances outlined below (box 2.1).

As shown, DWASA is already in a ‘water mining’ scenario (Khan, personal communication, 17 August

2011) with supply capacity 35% below demand level. Population increase and lack of rainfall groundwater recharge as a result of Dhaka’s unplanned concrete sprawl that leaves hardly any space tarmac free are contributing factors to this situation (Islam, personal communication, 16 August 2011). Moreover, low-income groups are seen to exacerbate consumption levels through illegal water connections meaning DWASA loses revenue (referred to as ‘non-revenue water’ (NRW)) while low-income consumers are forced to pay up to 10 times the DWASA rate to obtain supply (CBSG, 2010). With the majority of Dhaka’s low-income residents obtaining water through illegal means due to lack of formalised access, NRW collection is high resulting in utility vulnerability. With NRW levels affecting financial viability that can result in water shortages during peak demand periods, reducing unaccounted for water is required (World Bank, 2010: 19). With potential climate change impacts not the only pressure acting on water provision therefore, the question of how to adapt needs to be addressed.

2.5 Adaptation for urban water supply and sanitation services

The above recommendation forms part of the World Bank’s (2010) urban water utility adaptation framework, which offers proposals incorporating demand and supply-side planned adaptation interventions, as a means for DWASA to identify and screen climate change adaptation measures. These include (World Bank, 2010: 17-28):

- **Monitoring for climate change**: monitoring water resources, precipitation and water utility performance
- **Reduction of NRW**
  - **Water metering**: to reduce domestic water consumption
  - **Water tariffs**: key to reducing demand and increasing rational water use behavior among users
  - **Consumer behaviour**: imposing legal restrictions (direct means) to educational campaigns and corporate social responsibility (indirect means)
- **Integrated water resource management**: taking on board diverse stakeholders; reshaping planning processes; coordinating land and water resources management; recognising water quantity and quality linkages; conjunctive use of surface water and groundwater; and protecting and restoring natural systems (Nicol and Kaur, 2009: 5)
- **Diversification of water sources**: through the construction of new storage facilities, the appropriate and sustainable extraction of groundwater, or the use of recycled or desalinated
water

- **Enhancing storage capacity**: new dams and reservoirs, long-distance water conveyance or construction of additional reservoirs to alleviate variability in seasonal, monthly, daily and hourly water availability

- **Water reuse and desalinization**: for when existing water resources are constrained from meeting rising demands

- **Reallocation of water resources through market mechanism**: buying water rights from other users to meet urban water demand

Furthermore, based on recent research, Vision 2030\(^2\) has assessed the adaptability and vulnerability of management systems and water supply and sanitation technology, in accordance with JMP’s ‘improved sources’ as outlined in section 2.1 above. For Dhaka’s climate scenario of increasing rainfall and increasing rainfall intensity, the following results are presented (figure 2.7 below).

\(^{2}\) WHO/DfID’s Vision 2030 study assesses the resiliency of water and sanitation services to the impacts of climate change by 2030. This assessment accounts for both vulnerability to climate changes determined by engineering and environment, and adaptive capacity by the ability to be adjusted or managed so as to cope in response to different climate conditions (Howard and Bartram, 2010: 1).
Although access to water supply for the majority of Dhaka’s informal settlements dwellers is vulnerable due to the nature of its illegal connection, from a utility supply viewpoint, water is supplied by DWASA through a utility-managed piped water system. Based on figure 2.7 above, utility-run piped systems have high resilience to increased rainfall and rainfall intensity, although piped water as a technology is considered to have low resilience (table 2.1 below). This illustrates that management is able to overcome low resilience of technology (Howard and Bartram, 2010:1), hence management approach is more important than the technology itself in relation to piped water supply (Howard and Bartram, 2010: 15). Urban utility water supplies are potentially highly resilient to climate change if the utility is well-run, has human capital in the form of trained staff, and financial capital to invest in upgrading technology and new infrastructure (ibid).

Table 2.1: Water technology resilience to climate change: Vision 2030 (Howard and Bartram, 2010: 15).

As outlined, sanitation services and sewage disposal facilities in informal settlements is very poor, with the use of unimproved facilities believed to be widespread. The current situation is therefore vulnerable with any resiliency to climate change questioned. Nevertheless, pit latrines are the most resilient technology in this context (table 2.2 below), although vulnerable to flooding due to the possibility of environmental contamination and public health risks (Howard and Bartram, 2010: 18).
Table 2.2: Sanitation technology resilience to climate change: Vision 2030 (Howard and Bartram, 2010: 15).

2.6 Approaches to planning adaptation

As stated, to build the adaptive capacity of low-income inhabitants to climate change impacts on WASH practice, enabling adaptation strategies that address climatic and non-climatic risk factors is needed. Lack of access to safe water and sanitation services largely reflects existing development deficits – hence the relationship between adaptation and development ‘business as usual’ overlap.

Adaptation interventions can be viewed on a continuum (Calow et al., 2011: 20) (figure 2.8 below), from an ‘adaptation as development’ approach (Ayers and Dodman, 2010), which views adaptation as increasing the adaptive capacity of people to climate change and other stressors by taking a livelihoods-based view to assessing vulnerability, resulting in adaptation interventions that target the underlying drivers of vulnerability (Ayers, 2010: 108), to an impacts-based approach, which takes climate change impacts as the starting point for vulnerability assessments, giving rise to technological adaptation solutions that target the specific impacts of climate change, ‘adaptation plus development’ (ibid).

Figure 2.8: The adaptation continuum (Calow et al., 2011: 20).

This dissertation focuses towards the former; ‘adaptation as development.’ It is important to highlight that potential climate change impacts still need to be taken into account however, if adaptation interventions are not to prove maladaptive long-term (Ayers, 2010: 85). Existing adaptations still need to be ‘climate-proofed’ against future eventualities (Burton, 2004 cited in ibid).
2.7 What constitutes ‘adaptive capacity’?

As climate change presents an uncertain future that cannot be predicted (Arnell, 2009), adaptive capacity is indicated by flexibility in the face of unexpected and predicted hazards, vulnerabilities and their impacts (Pelling, 2011: 58). Communities are considered to have high adaptive capacity when they are able to anticipate, deal with, and respond to changing climate and development pressures, while maintaining (or even improving) their wellbeing (Levine et al., 2011: 3). The challenge for development practice is how to facilitate such adaptive capacity so people have the potential to act when needed (ibid: 9).

What constitutes adaptive capacity is highly debated, as it is not possible to measure ability or potential directly (ibid). In response, this dissertation uses the ACCRA\textsuperscript{25} ‘Local Adaptive Capacity’ framework as a guide for thinking what dimensions contribute towards adaptive capacity at local level. The Local Adaptive Capacity framework (figure 2.9 below) comprises of five characteristics: the asset base, institutions and entitlements, knowledge and information, innovation and flexible forward-looking decision-making and governance (ibid).

\textsuperscript{25} ACCRA stands for the Africa Climate Change Resilience Alliance. It is a research and capacity building consortium of Oxfam GB, the Overseas Development Institute (ODI), Care International, Save the Children and World Vision International that works in Mozambique, Uganda and Ethiopia.
2.8 Institutional service provision in Dhaka

Dhaka is administered by GoB through public sector ministries mandated to provide services to inhabitants living in the mega-city’s 10 zones and 90 wards (Rabbani et al., 2011). Dhaka City Corporation (DCC) is the key agency administering the city, with additional agencies (relevant to this dissertation) being Dhaka Water and Sanitation Authority (DWASA) (as introduced above) and the City Development Authority (RAJUK).

DCC’s responsibilities include urban planning, solid waste planning and management; rescue and relief activities in response to disaster events, and informal settlement development (Soltesova, 2010: 26). The Slum Development Unit within DCC is responsible for providing water, sanitation and drainage services to informal settlements. Moreover, each ward has its own democratically elected Ward Commissioner, who constitutes the most localised level of municipal government with activities primarily orientated towards social welfare and slum development (ibid: 21).

RAJUK manages Dhaka through the Dhaka Master Plan and Dhaka Metropolitan development Plan (1995-2015) (ibid). However, part of this plan, the Detailed Area Plan (DAP), submitted for approval in 2008, is stated to have no ambition to improve living conditions of low-income inhabitants (Soltesova, 2010: 26).

As shall be discussed in Chapter 4, lack of coordination between DCC, DWASA and RAJUK, allows each to avoid responsibility for low-income community service provision (CBSG, 2010: 18).
Chapter 3: Field Study
3. Field Study

“We rely on NGO now but we want good relationship and direct communication with DWASA and DCC in future”
Reena, 40, housewife, Kalshibalur Math, Mirpur, Dhaka (10 August 2011)

3.1 Field study location
Mirpur is located in north-east Dhaka, in DDC Ward 2, Zone 8 (figure 3.1). Two low-income communities in this area, Kalshibalur Math (East side) and Kurmitola Relief Camp (ibid), began developing in 1985 due to migrants inhabiting this low-lying government claimed wetland. These informal settlements are situated next to each other and at present occupy an area approximately 4000 sq.m on land that is 12 feet below the level of the main road and therefore prone to waterlogging. Moreover, these communities live next to a large lake that frequently floods during monsoon. Population density is high; at the time of research a combined total of 1,000 households lived in poor quality housing with inadequate access to basic services (water, sanitation and healthcare) or infrastructure (drainage provision). The majority of residents are Muslim. Main informal sector occupations include rickshaw pullers, home servants, garments workers, hawkers, masons, carpenters, small traders, landlords and house owners (CARE, 2010). No social institutions exist in this area except for an NGO school for working children (ibid). Local NGOs have worked with both communities to provide access to healthcare (which residents believe is unsatisfactory) and micro-finance. Most recently WSUP and CARE Bangladesh have undertaken a project focusing on providing safe water and sanitation.

(From left to right): poor household living conditions; looking up towards the main road; informal settlements located directly next to a large lake.
Figure 3.1: Map of Kalshibalur Math (East side) and Kurmitola Relief Camp, Mirpur, Dhaka, Bangladesh.
3.2 Data collection findings

3.2.1 Demographic and socio-economic profile

50 respondents completed a household questionnaire: 23 female (46%) and 27 male (54%). Respondents ranged from 15 to 65 years, with most aged 31 to 40 years (44%). The majority of respondents hold no (40%) or low formal educational qualifications (44%) meaning lack of knowledge (including rights to water and sanitation) and limited ability to access information and mechanisms that may enhance adaptive capacity. Most respondents are day labourers (28%), jointly followed by housewife and handicrafts (24%). Other occupations include small business, landlord, rickshaw puller and shopkeeper.

(From left to right): housewife undertaking daily chores; sari embellishment; wig making.

Most respondents (34%) have a combined household income between 6001-10,000 Bangladeshi taka/month (the equivalent of £48 - £80/month) indicating access to livelihood opportunities but low wages. 47 respondents (94%) have 1-3 household members generating income from diversified sources, with 3 respondents (6%) having 4-8 household members meaning higher household income levels. Increased number of income generating household members with diversified incomes reduces risk, however respondents with earning child household members indicates absence from school hence lowered future human assets increasing vulnerability.

37 respondents own their house (74%), however no respondents have secure land tenure with threat of forced eviction commonplace. Insecure land tenure means lack of access to municipal services with respondents reluctant to invest in infrastructure to improve housing.

32 respondents (64%) have access to savings from either personal funds, credit from an NGO, from membership of a savings group or from a bank. 28 respondents (56%) have taken out a loan to cover household expenditure when needed. 12 respondents (24%) have taken out a formal loan. 11 respondents (22%) have taken out an informal loan. As will be discussed, access to these financial
assets is essential for respondents in coping with and adapting to climate variability risk to WASH practice.

Based on the above information, respondents form four well-being categories (designated by respondents themselves in prior fieldwork undertaken by the CARE Bangladesh field team): 10 extreme poor (20%); 16 ultra poor (32%); 19 poor (38%); 5 lower middle class (10%) (Appendix 1).

Respondents have lived in Kalshibalur Math (East side) and Kurmitola Relief Camp for over a period of six months to 25 years. Reasons for residency include: birth (24%); seeking better income opportunities (40%); mobility due to river erosion (10%); attracted by the area’s low rent/cost of living (22%) and as a result of previous forced eviction (4%).

3.2.2 Respondent water profile
All respondents receive water supply through an illegal DWASA connection, which is insufficient for meeting daily needs. Water is supplied twice a day; at 10am and at midnight with the majority of water supply available at night. Respondents’ daily water requirement is therefore collected primarily at night and stored at home by all respondents. 96% of women collect drinking and domestic water for their households. Distance to collect water depends on homestead location within each informal settlement; 54% of respondents go between 5 to 50 feet to collect drinking water, while 42% go over 250 feet which entails crossing a busy main road and climbing a series of steep stairs. Homestead location does not directly correlate to well-being ranking with respondents within all groups experiencing different water collection distances. Using lake water for domestic chores (washing utensils, clothes) and personal bathing is commonplace.

Due to connecting to DWASA’s water supply through an illegal pipe system, water often gets contaminated due to unhygienic pollution entering pipes at weak connection points. Moreover, respondents use ring wells to collect water from this unhygienic pipe system. The majority of respondents do not treat drinking water before use (90%). Those that do use a water filter.

The majority of respondents pay up to 100 taka per month to ‘community power structures’ living outside the area for water supply (CARE, 2010).
### Water status

<table>
<thead>
<tr>
<th>Main drinking water source</th>
<th>Sufficient water supply</th>
<th>Distance to collect drinking water (feet)</th>
<th>Collect</th>
<th>Expenditure for water/month (taka)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DWASA</td>
<td>Other</td>
<td>Y N 5-50 51-100 100+ M F 0-50 51-100 101-200+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>0</td>
<td>0 50 27 2 21 2 48 15 26 7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 3.1:** Information regarding respondent water supply.

(From left to right): female household members collecting water; illegal piped water connections; ring well used for water collection.

### 3.2.3 Sanitation profile

All respondents use a pit latrine with slab – this technology is unhygienic and unimproved by JMP monitoring standards as latrines are uncovered, the slab is broken and is connected with an open drain that flows into the lake next to households. For respondents that share latrines, 30% share with up to 5 households, 54% share with 6 to 10 households, and 26% share with 10+ households.

<table>
<thead>
<tr>
<th>Latrine status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of latrine</strong></td>
</tr>
<tr>
<td>Improved</td>
</tr>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

**Table 3.2:** Information regarding respondent latrine usage.
3.2.4 Hygiene profile
Due to the incorporation of hygiene promotion in the WSUP project in progress at the time of research, 46 respondents (92%) were aware of personal hygiene issues including using soap for handwashing after going to the toilet and before eating. All female respondents except one undertook handwashing with soap before preparing food. 21 female respondents (91%) stated menstrual hygiene awareness.

3.2.5 Waste management profile
No waste management exists in either informal settlement. Rubbish is disposed of where respondents see fit. Moreover, no drains exist for rainwater discharge. What drains do exist are of poor capacity.

3.2.6 Community perceptions of environmental risk
All respondents perceived an increase in temperature compared to their childhood in response to being asked what were the biggest weather related issues they faced today. The majority of respondents perceived longer flooding periods and changes in rainfall patterns. One extreme poor
(10%) and one poor respondent (5%) voiced water-logging as an additional risk.\(^{26}\)

Figure 3.2: Community perceptions of environmental risk divided by well-being ranking.

### 3.2.7 Community perceptions of non-environmental risk

Respondents from all well-being groups perceived similar challenges to WASH practice. Fieldwork findings reveal that disaggregation in risk is gender-based rather than well-being group based; all female respondents irrespective of well-being category stated similar risks. Challenges applicable to women and adolescent girls (ADG) are identified separately below (table 3.3).

<table>
<thead>
<tr>
<th>Perceived non-environmental risk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water</strong></td>
</tr>
<tr>
<td>All: Illegal connection; Scarcity (particularly during summer); Unreliable supply; Contamination (especially during flooding); Increasing population pressure due to in-migration</td>
</tr>
<tr>
<td>Female: Unsafe/long distance/time consuming water collection (especially during summer/flooding when have to seek alternate source of drinking water supply located over 1km away); Unable to maintain menstrual hygiene practices - ADG unable to go to school</td>
</tr>
<tr>
<td><strong>Sanitation</strong></td>
</tr>
<tr>
<td>All: Unhygienic latrines; Not enough latrines; Children always practice open defecation</td>
</tr>
<tr>
<td>Female: Dangerous for women and ADG to use latrines at night due to harassment</td>
</tr>
<tr>
<td><strong>Hygiene</strong></td>
</tr>
<tr>
<td>All: Lack of hygiene awareness within the community; Dirty environment/no access to waste management facilities</td>
</tr>
<tr>
<td><strong>Health</strong></td>
</tr>
<tr>
<td>All: High levels of water-borne and skin disease/illness; Lack of access to healthcare services; Dependence on microfinance from neighbour/relative/NGO for medicine/food; Lack of nutritious food (especially during the summer)</td>
</tr>
<tr>
<td><strong>Other</strong></td>
</tr>
<tr>
<td>All: Lack of land tenure; Lack of access to satisfactory education</td>
</tr>
<tr>
<td>Female: Lack of income opportunities</td>
</tr>
</tbody>
</table>

\(^{26}\) The environmental categories displayed above are adapted from Jabeen et al., 2010.
Table 3.3: Community perceptions of non-environmental risk divided by gender.

3.2.8 Responses to local climate variability impacts on WASH practice
Respondents from all well-being rankings voiced similar impacts and responses to increased temperature and rainfall, contributing to increased flood risk on WASH practice. Again, fieldwork findings show that response strategies vary according to gender and access to specific household social networks. As FGDs elaborated on household questionnaire findings, results from both are presented together in table 3.4 (increased temperature) and table 3.5 (increased flood risk) below. Information relating specifically to female respondents is in bold.

<table>
<thead>
<tr>
<th>Impact of increased temperature on WASH</th>
<th>Result of impact</th>
<th>Autonomous adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less water available / reduced access</td>
<td>Reduction in personal hygiene practices, especially hand-washing after going to the toilet and bathing.</td>
<td>Collect water from alternate source (tubewell) from further distance, at a higher price and with longer waiting time due to increased people using same water source (less time for income generation). Collect less water than needed for daily requirements. Only collect water at night (as more water available). Increased bathing in lake. Minimal wash and change of menstrual period cloth (ADG). Take water from neighbour’s/relative’s house. Cook only once a day. Buy mineral water (if can afford it). Take loan from neighbour/relative/NGO to buy medicine from pharmacy (can’t afford to see a doctor).</td>
</tr>
<tr>
<td>Difficult to store water in HH. Increased disease/health issues.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor waste management conditions</td>
<td>Worse conditions due to heat</td>
<td>Adjusted to increased bad smell.</td>
</tr>
</tbody>
</table>

Table 3.4: Respondent response strategies to impacts of increased temperature on WASH practice.
<table>
<thead>
<tr>
<th>Less water available / reduced access</th>
<th>Reduction in personal hygiene practices, especially hand-washing after going to the toilet and bathing.</th>
<th>Collect water from alternate source from further distance, at a higher price and with longer waiting time due to increased people using same water source (less time for income generation). Collect less water than needed for daily requirements. Only collect water at night (as more water available at this time). Minimal wash and change of menstrual period cloth (ADG). Collect rainwater for drinking (water filter is used by some HH before drinking). Take water from neighbour’s/relative’s house. Take bath once every 2-3 days. Cook only once a day. Move family to relative’s house in Dhaka during flooding periods. Return to village during flooding periods. Rely on outside support (army provide 2-3 drums of water during flooding periods). Buy mineral water if can afford it. Store water in unsafe containers (due to collecting more water in one go at night). Take loan from neighbour/relative/NGO. Buy medicine from pharmacy (can’t afford to see a doctor).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unable to complete all domestic HH activities (cooking, washing etc.).</td>
<td>Difficult to store water in HH.</td>
<td></td>
</tr>
<tr>
<td>Increased water-borne disease/skin disease.</td>
<td>Reduction in water quality</td>
<td>Piped water supply contaminated (faeces, insects, iron).</td>
</tr>
<tr>
<td>Reduction in water quality</td>
<td>Increased unhygienic sanitation</td>
<td>Latrines inundated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increase in lack of dignity.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increase in water-borne disease / reduced worker productivity.</td>
</tr>
<tr>
<td>Increased poor drainage/sewage systems</td>
<td>Overflow of drains/latrines. Polluted flood water inside homesteads.</td>
<td>Stay inside homestead on raised bed all day due to overflow of faeces: undertake all HH activities on bed (incl. cooking). Eat dry food (as unable to collect water due to surrounding flood water). Make artificial drain near homestead; clean house with spade more than normal. Move homestead to higher ground (to informal settlement on opposite side of main road). Children do not attend school. Raise height of water tap.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Schools close due to flooding. Water taps inundated.</td>
</tr>
<tr>
<td>Increased poor waste management</td>
<td>Worse conditions due to flood water.</td>
<td>Throw rubbish directly next to homestead.</td>
</tr>
</tbody>
</table>

Table 3.5: Respondent response strategies to impacts of increased flooding on WASH practice.
Insufficient water supply for daily use during increased (summer) temperatures and flooding periods is voiced, with water supply in summer stated to be worse due to severe water scarcity. Women and ADG FGD respondents stated a decline in personal hygiene practices occurs mixed with a rise in diarrhoea spurred on by ingesting unwashed and rotten food. As a result, respondent health is worse during periods of increased heat compared to flood periods.

During flood periods, water is more readily available but is highly contaminated due to poor capacity piped water, sewage and drainage systems. As a result, female FGD respondents stated that rainwater is depended on for drinking.

(Left): Collecting rainwater using a plastic sheet tied to homestead - Musharuf, 40, garments worker.

(Right): Inside Musharuf's house, rainwater is collected in silver utensils as it drips down between the gaps in the roof. His family drinks rainwater directly without using a water filter.

Similarly, due to flooding of contaminated water within the community area, female respondents prefer to say inside their homesteads than go outside and walk in an unhygienic environment. Some respondents stated they prefer not to eat than have to leave the house to buy vegetables. Moreover, male and female respondents stated that all household activities are undertaken on the household bed, including cooking, with beds raised above flood water with bricks or alternate materials.

(Left): Materials used to raise beds.

(Right): Height of flood water inside homestead after a short periods of rainfall.

Other physical modifications include raising water taps above flood water height using pieces of wood as temporary stands to avoid inundation.
Skin disease is common amongst respondents due to flooding/water-logging, with resulting medical care being an expensive added burden to household expenditure. With flood periods severely affecting household ability to generate income due to the volume of flood water inhibiting activity, increased medical expenses combines with less income so respondents “get it both ways” (male FGD, 8 August 2011).

“Medicine cost 500 taka (£4) last month.”
Akhi, 14 years, ADG

(From left to right): skin disease due to water-logging; Akhi.

Strong social networks between respondents aid ability to cope. Respondents cover increasing medical costs by using household savings where applicable, or by taking out a loan, mostly from neighbours or family members. Neighbours also share water and latrines with each other when needed. Moreover, for the three respondents that relocate to non low-lying land during flood periods within Dhaka, this is possible due to family networks. Moving to a safer location is however not plausible for all respondents due to lack of social networks and/or the potential loss of assets incurred by moving. Furthermore, family support enables one female respondent to undertake hygienic food preparation at her nearby sister’s house, thus ensuring her family does not suffer from diarrhoea disease.

The majority of respondents rely on a combination of neighbouring households (58%), CBO leaders (86%) and NGOs (88%) for support. Community cohesion is enhanced by a Slum Development Committee that meets on a monthly basis to solve community-based issues. 26% of respondents state their local DDC Ward Commissioner (the lowest tier of local government) offers support. The Ward Commissioner is however constrained to act due to lack of funding, power and revenue-raising capacity (Shaheen, personal communication, 8 August 2011).
### Local institutional support

<table>
<thead>
<tr>
<th>Neighbours</th>
<th>CBO Leaders</th>
<th>NGO (in Dhaka)</th>
<th>Relatives (in Dhaka)</th>
<th>Local Service Provider</th>
<th>Ward Commissioner (DCC)</th>
<th>Landlord</th>
<th>Employer</th>
<th>Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>43</td>
<td>44</td>
<td>13</td>
<td>4</td>
<td>13</td>
<td>4</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

**Table 3.6:** Respondent perceptions of local institutional support.

### 3.2.9 Community perceptions of required support

For respondents to strengthen their capacity to cope with and adapt to impacts of increased temperature and flooding on WASH practice, respondents stated they require (in no particular order):

- Improved access to basic services (water, sanitation and healthcare)
- Improved infrastructure (drainage provision)
- Capacity to develop communication skills and channels with DWASA and DCC (improved relationship)
- Land tenure security
- Increased income generation activities during flood periods
- Increased capacity to understand climatic changes and plan needed adaptations (knowledge on expected climatic impacts and how to adjust their WASH and livelihood practice).

### 3.2.10 Key informant responses on facilitating pro-poor adaptation to WASH practice

Key informant interviewees (Appendix 2) stated the following issues and recommendations to improve facilitation of pro-poor adaptation to WASH practice for respondents.
<table>
<thead>
<tr>
<th>Actors</th>
<th>Issues</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil society</td>
<td>Rapid migration into Dhaka.</td>
<td>Increase the rural economy and employment activities outside of Dhaka. GoB policy restricting migration into Dhaka. Decentralisation of facilities to other urban centres (Khulna/Chittagong) – systematically develop these cities to attract migrants. Incentivise inhabitants to move out of Dhaka.</td>
</tr>
<tr>
<td></td>
<td>Declining groundwater levels.</td>
<td>Water regulation extraction policy needs to be urgently enforced and adhered to. Need to re-think concrete urban development. Inhabitant education required on how to store surface water/rainwater.</td>
</tr>
<tr>
<td></td>
<td>Lack of climate change awareness on urban areas within DWASA/DCC.</td>
<td>DWASA/DCC to head up a climate change research cell. DWASA/DCC to assess impacts of climate change and initiate a climate change strategy in conjunction with Bangladesh Meteorological Centre – analysis of climatic data spanning over the next 30 years is required in order to address future climate change. DWASA needs to initiate an adaptation programme for emergency periods. DWASA needs to initiate a water treatment plan.</td>
</tr>
<tr>
<td></td>
<td>DWASA’s Low-income Community Cell (LICC) receives limited institutional support.</td>
<td>Undertake appropriate capacity building. Increase funding allocation and trained manpower. Incentivise staff to reduce illegal connections and non-revenue water levels. LICC required in each zonal level office across Dhaka, not just in DWASA head office.</td>
</tr>
<tr>
<td></td>
<td>Lack of understanding of how global climate models will impact at local level.</td>
<td>Global climate models need to be downscaled to local level. CEGIS (Centre for Environmental and Geographic Information Services) is presently working with the UK Meteorological Office to develop a specific Bangladesh climate model.</td>
</tr>
<tr>
<td></td>
<td>Current (WASH) projects cater only to climate variability not climate change.</td>
<td>New area of research required by GoB/NGOs/think tanks to understand how to transition from current climate variability to future long-term climate change. Research to be based around the question: is investment made now going to last over the next 30 years?</td>
</tr>
<tr>
<td></td>
<td>Increased threat of health/disease linked to WASH and climate change impacts for low-income communities.</td>
<td>Specific programmes on WASH and climate change in urban centres required. Sustainable development package of health, climate change, WASH, hardware technology to be delivered. Capacity strengthening of low-income communities to improve understanding of climate change on water resources and sanitation issues. Education within schools to incorporate climate change impacts on water resources and sanitation issues.</td>
</tr>
<tr>
<td></td>
<td>Lack of research on climate change impacts on WASH practice, especially in urban areas.</td>
<td>Research to be undertaken in urban areas. Research to be undertaken on sustainable water supply and sanitation technology. BCAS (Bangladesh Centre for Advanced Studies) and NGO Forum presently researching climate change impacts on WASH in hard-to-reach rural areas. CEGIS presently researching how climate change impacts will affect groundwater in rural areas in conjunction with WaterAid – possible urban areas forthcoming.</td>
</tr>
<tr>
<td></td>
<td>Lack of GoB understanding of</td>
<td>Advocacy to influence GoB decisions.</td>
</tr>
<tr>
<td>Issue</td>
<td>Recommended Action</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>how to tackle urban/climate change issues.</strong></td>
<td>Capacity building. Increased awareness and focus of policy makers on urban issues: UNDP’s Urban Forum (first held in October 2011) aims to sensitise policy makers to urban issues.</td>
<td></td>
</tr>
<tr>
<td>Neglect of low-income communities in urban planning.</td>
<td>Equal rich/poor urban planning required. Capacity building.</td>
<td></td>
</tr>
<tr>
<td>Lack of climate change issues mainstreamed into WatSan policy</td>
<td>Advocacy required to mainstream climate change and climate issues into all national, sub-national and sectoral planning processes. NGOs/CBOs to play a vital role in facilitating this.</td>
<td></td>
</tr>
<tr>
<td>Climate change needs to be seen as a key concern by local institutions, not just as a way to secure funding.</td>
<td>Advocacy and awareness raising to improve understanding of climate change impacts.</td>
<td></td>
</tr>
<tr>
<td>Lack of land tenure for informal settlement dwellers / lack of political will</td>
<td>No recommendations made.</td>
<td></td>
</tr>
<tr>
<td><strong>Government</strong></td>
<td><strong>WaterAid/DSK’s NGO mediated water and sanitation service delivery SIM model is not sustainable over the long-term (CBOs are not permanent so DWASA experiences profit loss with unpaid bills).</strong></td>
<td></td>
</tr>
<tr>
<td>Research cell within NGOs focusing on sustainable WASH projects for low-income urban communities required.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low-income communities refuse water points/latrines due to lack of space.</td>
<td>NGOs need to increase WASH education and hygiene promotion within low-income communities.</td>
<td></td>
</tr>
<tr>
<td>Climate change impacts on drainage/sewage.</td>
<td>DWASA is currently initiating a Sewage Master Plan (finalised mid-2012). New pipelines and five new treatment plants to be constructed. Drainage Master Plan forthcoming.</td>
<td></td>
</tr>
<tr>
<td>Declining groundwater.</td>
<td>A 10-year plan commenced in 2010 to shift from current 87% reliance on groundwater to only 40% reliance by 2020. Four treatment plants in Dhaka for surface water to be constructed, bringing Padma and Meghna river water into Dhaka.</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.7: Key informant issues and recommendations to facilitate pro-poor WASH adaptation.
Chapter 4:
Analysis and Discussion
4. Analysis and Discussion

4.1 Assessing the adaptation deficit
In order to build the adaptive capacity of respondents to potential future climate change impacts on WASH practice, respondents’ existing capacity to cope with and adapt to current climate variability risk – their ‘adaptation deficit’ - needs to be understood (Burton, 2004 cited in Ayers, 2010: 84). Adaptation strategies aimed at reducing this deficit to increase people’s resilience to climatic variation is needed before adaptation to future climate change can occur (ibid).

To this means, the autonomous adaptation strategies – *the spontaneous, automatic or passive adaptation that occurs as part of the routine of a social system* (Pelling, 2011: 15) *irrespective of external financial or technical assistance* (Ayers, 2010: 84) – undertaken by respondents as illustrated in Chapter 3, are indicative of their current capacity to cope with and adapt to climate variability impacts. Fieldwork findings show that social assets are central to this capacity; strong relationships between neighbouring households and extended family members provide livelihood security by sharing physical (water) and financial (loan) assets so medicine can be ascertained to cope with rising disease incidences during increased temperature and flooding periods, and food, as disease and an environment inundated with flood water inhibits ability to generate income. Similarly, respondents able to relocate to higher ground during flood periods have access to do so due to family networks.

Unsanitary conditions exacerbating public health risks combined with lack of access to employment opportunities during flood periods, means one respondent undertakes urban-rural migration as a means to adapt for the duration of flood episodes. Access to employment opportunities was the initial reason to migrate. For another respondent, livelihood diversification from rickshaw puller to day labourer was undertaken. With flood water decreasing ability to use a rickshaw, increased chances of receiving income for food and medical costs from change in employment underpinned the shift. Moreover, access to drinking water during flood episodes when illegal water supply is highly contaminated was provided by rainwater collection by all respondents. However, based on Vision 2030’s findings, rainwater collection has low resiliency to Dhaka’s potential climate change

27 Among academic circles there is on-going debate regarding whether migration is adaptation, or is a failure to adapt (Warner et al., 2009: 2). It is often assumed that migration is a failure to cope with existing circumstances, however migration is also seen as a legitimate adaptation strategy that increases household resilience to negative climate impacts (Kniveton et al., 2008: 33).
impacts due to issues of sustainability (Howard and Bartram, 2010: 15). Depending on rainwater collection long-term is therefore unfeasible. Likewise, buying mineral water (if household expenditure allows) is unsustainable for respondents. This extra expense in addition to paying high prices for an illegal water connection that appears virtually redundant during flood periods is not viable in a context of limited income.

Fieldwork findings show that autonomous adaptation strategies relating to sanitation practices during flood periods increase respondent vulnerability. An increase in open defecation and the construction of hanging latrines next to homesteads raises the threat of disease, including diarrohea and dysentery.

Furthermore, fieldwork findings show that autonomous adaptation strategies distinguished by gender also increase respondent vulnerability. To ensure water availability for households during periods of increased temperature and flooding, female respondents collect water from a further distance with increased collection time and higher expense, taking time away from other household activities. Moreover, due to inappropriate sanitation not providing privacy and security for female inhabitants (Joshi, 2009), women and adolescent girls wait until dark to find an isolated spot if latrines are inundated, leaving them open to threat of harassment and pain by waiting (Amnesty, 2010). Similarly, due to lack of water for washing menstruation cloth and inadequate sanitation facilities at work, home and school, women and adolescent girls unable to maintain menstrual hygiene cope by washing their cloth as little as possible and sometimes do not attend work or school. With climate change impacts set to exacerbate the existing reality (Raihan et al., 2010), these findings support the statement that climatic impacts may affect women more than men (GoB, 2011).

At household level, fieldwork findings show respondents’ autonomous adaptation options are limited (Bartlett et al., 2008). Respondents’ primary perception of risk to WASH practice stems not from exposure to an environmental hazard depicted by increasing temperatures and flooding, but from the illegal nature of water supply and unhygienic sanitation which serves as a springboard for ill-health. This risk is institutionally determined; stated by DWASA to be the result of respondents’ insecure land tenure and threat of forced eviction (Roy, personal communication, 9 August 2011) making low-income settlements not commercially viable to invest in (CBSG, 2010). Respondents are not recognised as citizens with rights to water and sanitation, and they do not possess land-holding numbers offering tenure security because they are marginalised. With limited access to resources constraining household agency, escaping poverty in order to change social standing is challenging (Banks, 2010). Poverty, inequality and the local institutional context (Kelly and Adger, 2009: 163
cited in Ayers, 2010) therefore limits the ability of those most at risk to adapt to climate variability impacts, keeping respondents trapped in cycles of largely vulnerability generating behaviour.

With the root cause of climatic risk relating to social dimensions of vulnerability, inadequacies in basic service provision and infrastructure cannot be addressed by autonomous adaptation responses alone, as they cannot provide long-term solutions that address underlying causes of risk (Bartlett et al., 2008: 35). Respondents’ autonomous adaptation strategies show means to cope with and adapt to the ‘symptoms’ of climate variability on WASH practice; however moving beyond symptoms is needed if adaptation is to target the social root ‘causes’ of vulnerability. Adaptation that targets social root causes leverages ‘transformational’ change; that is change to the overarching political-economy regime in line with Pelling’s climate change adaptation framework (Pelling, 2011: 86).

In order to reduce respondents’ adaptation deficit and hence strengthen their adaptive capacity, respondents voiced what support they require. As previously outlined, this is: (i) improved access to basic services (water, sanitation and healthcare); (ii) improved infrastructure (water, sanitation and drainage provision); (iii) capacity to develop communication skills and channels with DWASA and DCC (improved relationship); (iv) land tenure security; (v) increased income generation activities during flood periods, and (vi) capacity to understand expected climatic changes and plan needed adaptations (knowledge on expected climate impacts and how to adjust their WASH and livelihood practice to these impacts).

4.2 Addressing the adaptation deficit
The WSUP project in operation at the time of research aided the facilitation of reducing respondents’ adaptation deficit through development interventions. At household level, five improved water points (one tube well per 100 households) and 36 hygienic pit latrines (connected to a septic tank) were in the process of being constructed in each informal settlement. Based on Vision 2030’s findings, tube wells are most resilient to Dhaka’s climatic impacts of increased rainfall and rainfall intensity (Howard and Bartram, 2010). Pit latrines are however vulnerable to flooding due to possible environmental contamination and public health risks (ibid). To counteract this, each tube well and pit latrine was raised 3.5 feet from the ground to make infrastructure resilient to flooding. The height to raise infrastructure was decided upon based on respondent input of flood water levels from past experience. Moreover, to start addressing inadequacies in drainage provision to reduce
the threat of flooding, the WSUP project constructed two drains in each informal settlement.  

Following Pelling’s framework, these technological changes can be viewed as adaptation as resilience: action to protect priority functions in the face of external threat associated with climate change (Pelling, 2011: 67). By strengthening water and sanitation infrastructure to flood risk, respondents’ physical assets are strengthened by reducing exposure and susceptibility of water and sanitation facilities to water supply contamination potentially leading to public health issues (ibid: 22). Consequently, respondents’ human assets (health) are supported, as is the case with drainage provision that aims to reduce environmental pollution and resultant disease. These actions to ‘climate proof’ infrastructure to enhance sustainability therefore aim to maintain functional persistence (ibid). Access to improved infrastructure is set to enhance respondents’ asset- portfolios and hence adaptive capacity, as assets give capability to be and act in order to reduce risk and to cope with and adapt to increased risk levels (Moser and Satterthwaite, 2008: 7).

However, past flood levels are not necessarily indicative of future flood levels. Key informant findings show that to enable sustainability of investment or action from current climate variability impacts to future climate change, the following question needs to be asked: is investment or action made now going to last over the next 30 years? (Huq, personal communication, 3 August 2011). As a result, GoB, NGOs, thinktanks and other decision-makers are suggested to work with the Bangladesh Meteorological Centre to analyse local climatic data spanning over the next 30 years to gauge an understanding of what possible impacts might be and hence what response is likely to be required (Rabbani, personal communication, 9 August 2011). This action is identified as making development adaptive to future climate change risk, compared to development ‘business as usual’ that does not take potential climate change impacts into account, or disaster risk management measures that aim to address climate variability – for example, adapting to current flood levels (Huq, personal communication, 3 August 2011). At present, this shift in focus is not happening, hence its requirement (ibid).

Drainage construction did not initially form part of the WSUP project’s Terms of Reference, however funding for drain provision was attained via donations in response to an ABC News fund set up to raise money for both informal settlements. As the WSUP project has now ended (January 2011), drainage provision is being taken up by UNDP’s (United Nations Development Programme) UPPR (Urban Partnerships for Poverty Reduction) Project that has started working with respondents.

This statement is made following information expressed by Ainun Nishant, Vice Chancellor, BRAC University during the ‘Water, Waves and Weather Workshop’, Dhaka, Bangladesh, 18 July 2011.
Seeking local climate data was not undertaken by development practitioners facilitating the WSUP project prior to building respondents’ water, sanitation and drainage infrastructure. Hardware resiliency to future climate change impacts is therefore unknown with future threat of inundation possible. This forward-looking investment to improve resiliency may be maladaptive; it may improve resiliency in the short-term, however it may potentially generate respondent risk to climate change impacts over time.

However, developing adaptation plans is difficult with uncertainty as to what climate change actually implies at local scale (Ayers, 2009: 233). The above finding highlights the need to downscale climate modeling data to enable climate change analysis that incorporates an understanding of how drivers of water stress will interact at local level (Calow et al., 2011). This downscaling needs to provide information that is relevant, credible, and is needed as far as it can be usefully meaningful to the risks people experience everyday across sectors and scales, in conjunction with sustaining climate observation networks at local and regional levels (Ayers and Huq, 2008). Screening projects for climate risk could be quick and straightforward provided the appropriate climate risk information is readily available (Ayers, 2009: 234).

This does not however mean that it is necessary to wait for local climate change data to become available to start building respondents’ adaptive capacity (Ayers and Huq, 2008). As vulnerability to climate change impacts on WASH practice is largely the result of development deficits that do not address the needs of the urban poor due to underlying social and political issues (Raihan et al., 2010), reducing vulnerability by facilitating sustainable development packages that target the symptoms and causes of these deficits is key. This means encouraging WASH practitioners to move beyond technical fixes to broader strategies aimed at non-climatic risk factors regarding equity and access.

Moreover, for local climate information to inform sustainable development plans and policies, awareness of its existence and relevance to decision-makers must be raised to ensure use (Ayers and Huq, 2008). Similarly, the information is to be presented in a format applicable to practical action by different stakeholders, including policy makers, planners, civil society organisations and research

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30 Screening involves the systematic examination of an agency’s set of policies, programmes or projects, with the aim of identifying how concerns about climate change can be combined with an agency’s development priorities (Ayers and Huq, 2008). Such screening helps in identifying both which existing development projects are particularly threatened by climate change; and to identify opportunities for incorporating climate change more explicitly into future projects and programmes (ibid).
communities (ibid). Local government officials are unlikely to act on climate change unless its immediate relevance for their city and their sectoral concerns are made evident (Satterthwaite et al., 2007: 57). Developing the knowledge base of GoB, NGOs and other relevant decision-makers to transition their current understanding of what constitutes adaptation to facilitating adaptation specific to climate change is therefore needed. To this means, investment in institutional capacity building across all scales is required, particularly at the municipal level and with participation from local communities (Ayers and Huq, 2008). Communication channels and forums to support information and skills transfer is suggested (ibid).

Granting access to flood-resistant water infrastructure will deliver greater benefits to respondents if local mandated service providers ensure sustainable access to safe, sufficient and affordable water supply (Levine et al., 2011). In order to address deficiencies in current service provision and thereby reduce respondents’ adaptation deficit, the WSUP project supported respondents with local institutional collaboration as a means to promote an initial basis for partnership. This collaboration is essential if climate change adaptation is to move beyond a technical domain towards recognition of the essential importance of its social dimensions (Moser and Satterthwaite, 2008: 33).

Following the NGO-pioneered social intermediation service delivery model (SIM), which creates a workable link between DWASA and low-income communities (CBSG, 2010: 15), WSUP supported respondents with providing a legal water connection to the nearby DWASA line. This action to reduce vulnerability to climate risk by asserting respondents’ rights to water that have been suppressed within DWASA’s existing governance system (Pelling, 2011: 69), is *adaptation as transition*. It is not transformational as it not pushing to overturn DWASA’s established regime (ibid: 74), however transitional change is facilitated by external pressure from WSUP being acted upon by DWASA, as respondents’ lack of adaptive capacity inhibits their ability to exert pressure from the ground up themselves due to social and political factors discussed (ibid: 78).

In order for the SIM model to be operationalised, DWASA require informal settlement dwellers to form a CBO in order to apply for water connection (CBSG, 2010: 15). After initial WSUP involvement with establishing funding and hardware and applying to DWASA for a legal water connection on behalf of respondents, WSUP hand ownership of connection permission to the CBO so respondents have direct communication with DWASA (Roy, personal communication, 9 August 2011). While DWASA is responsible for providing legal water connection, the CBO is responsible for internal

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31 This service delivery model was initiated by NGOs WaterAid Bangladesh and its local partners DSK (Dustha Shastha Kendra) and PTSC (Population Services and Training Centre) in 1992 (Akbar, 2007).
management functions, with the Ward Sanitation Task Force responsible for monitoring CBO activities (CBSG, 2010: 16).

Building on respondents’ community capacity to work collectively based on the existing Slum Development Committee, WSUP worked with respondents to develop a CBO\textsuperscript{32} by (i) empowering respondents with knowledge about their water and sanitation rights; (ii) developing social capital in order to support community management of shared resources (CBSG, 2010: 18), and (iii) building the capacity of respondents’ communication skills with DWASA and DCC.

By empowering respondents to present a collective voice for negotiations with DWASA and DCC, these actions can be seen as adaptation as transition (Bartlett et al., 2008: 29). With WSUP providing respondents with access to information and mechanisms to demand basic services to which they are entitled (CBSG, 2010: 21) and by facilitating changes in their capacity to act, the following quote indicates respondents’ perceived enhanced social ability and hence strengthened adaptive capacity.

\begin{quote}
“We plan to communicate with the Health and Land Minister in the future through the DCC Ward Commissioner. We can now do this as NGO making us have more communication.”
Md. Joynal, CBO Leader of Kalshibalur Math, Mirpur, Dhaka (16 August 2011)
\end{quote}

Similarly, respondents’ perceived enhanced social ability is indicated by female respondent institutional mapping findings. Empowered with knowledge of their water rights, female respondents stated ability to exert influence over DWASA, rather than DWASA exerting influence over them.\textsuperscript{33} However, lack of confidence inhibited female respondents acting on this perception. Nevertheless, empowering respondents to be a collective entity and active citizens is a base that can be developed and strengthened into more proactive mechanisms for adaptation (Bartlett et al., 2008: 4). These ‘transitional’ changes therefore contribute to reducing respondents’ adaptation deficit and indicate potential for development.

\subsection*{4.3 Assessing the adaptation gap: DWASA and DCC}

To build respondents’ adaptive capacity, change at municipal level to facilitate improvement and

\textsuperscript{32} CBO members, comprising of male and female inhabitants, were appointed based on community votes.

\textsuperscript{33} In comparison, male respondents felt that DWASA still yields influence over the community.
extension of pro-poor access to safe water and sanitation services remains imperative. As NGOs should not replace local service providers but empower them to do their job (Shaheen, personal communication, 24 July 2011), WSUP worked on building the institutional capacity of DWASA (and DCC) to facilitate pro-poor service delivery as improved competence, capacity and accountability increases adaptation capacity and the possibilities of it being pro-poor (Satterthwaite et al., 2008: 59); adaptation as transition.

DWASA’s current capacity to facilitate pro-poor service provision is currently constrained by institutional barriers coupled with operational malpractice (CBSG, 2010: 28). Key issues with service delivery mechanisms are (ibid):

- Fragmented approach to service delivery: confusion between agencies (DCC, DWASA, RAJUK), especially in regard to sanitation.
- No incentive within DWASA at local level to improve services to low-income communities or to coordinate service delivery with DCC.
- Ineffective organisational structure: low-income community water supply is coordinated by the Commercial Manager (CM) as an additional function managed on ad hoc basis through DWASA’s new ‘Community Programme and Consumer Relation Division’ based at Headquarters (HQ). This new division is under the CM due to historical practice, however the CM has no direct link with or authority over the local MODS zones responsible for service delivery. The division is headed by a Senior Community Officer under the CM and has a total of three staff (at the time research was undertaken) to serve 3.4 million informal settlement inhabitants living in the DWASA service area (ibid: 19). The new division is an attempt to formalise existing ad hoc institutional procedures that allowed DWASA to decide when and where to allow access to services for the urban poor via the SIM model, however coordination between HQ and zone level is difficult (ibid: 28).
- Existing policy framework inhibits DWASA from serving the urban poor more efficiently as (i) DWASA procedures do not allow private participation in water production and sale meaning the regulation of quality of service and pricing of informal water vendors is unmonitored; and (ii) GoB’s National Sanitation Policy advocates for single pit latrines in urban areas which is not an appropriate technology for high–density contexts (ibid: 6).

The creation of the new ‘Community Programme and Consumer Relation Division’ division, or Low-income Community Cell, shows the intention of the CM within DWASA to provide a proactive
approach to institutionalising pro-poor service delivery (ibid); *adaptation as transformation.* However, institutional constraints encompassed by lack of manpower, funding and recognition by DWASA management, plus unclear roles and responsibilities (Shaheen, personal communication, 8 August 2011) inhibits turning this intention into action. Despite the creation of a new division, no institutional structure or human resources within DWASA are designated to manage and coordinate informal settlement level service delivery (CBSG, 2010: 21). New positions created increase human resources in existing positions rather than those allocated to specifically serve the needs of low-income communities (ibid: 23).

**4.4 Addressing the adaptation gap: DWASA and DCC**

To empower DWASA to act on providing a proactive approach to low-income community service provision therefore, the following recommendations are made (Shaheen, personal communication, 8 August 2011):

- Increase funding allocation to the Low-income Community Cell
- Increase trained manpower to ensure functional effectiveness (especially at central and zonal committee level)
- Incentivise staff to reduce illegal connections and non-revenue water levels
- Introduce a Low-income Community Cell in each zonal office across Dhaka (rather than one solely located at DWASA HQ)

In addition (CSBG, 2010: 8 – for complete details see Appendix 8):

- For DWASA to assert its policy of an equitable approach to water service provision for all inhabitants within its service area
- Introduce a Low-income and Slum Community Services Support Cell at DWASA HQ
- Promote initiatives for private participation in the distribution of water in low-income communities by introducing regulatory measures that safeguard the urban poor from monopolistic water-pricing
- Review alternative tariff structures for different consumer groups in different consumer areas
- Instigate an action-learning programme to understand urban sanitation and hygiene behaviour so appropriate plans for sanitation and hygiene promotion can be initiated.

Moreover, based on the above information, the following is also needed:
• Sensitize DWASA management to Low-income Community Cell operations to ensure recognition and support
• Sensitize key decision-makers at DWASA and its Low-income Community Cell to climate change and potential impacts on WASH for the urban poor
• Introduce a Climate Change Research Cell with trained staff at DWASA and DCC
• Review DWASA and DCC policies and plans to assess integration of risk reduction and climate change adaptation (Rabbani et al., 2011: 539) and aid support as required based on findings
• Initiate an adaptation programme for ‘emergency’ periods at DWASA and DCC
• Increase competency and co-ordination between DWASA, DCC and RAJUK

Facilitating institutional change is a long-term process; hence long-term commitment from development assistance is required rather than fixed term projects. This notion is important to highlight as the WSUP project draws to a close.

The potential to improve and extend provision of water and sanitation for respondents largely depends on the approach used by stakeholders involved in service delivery. Key informant findings show that the present CM views the SIM model as unsustainable long-term. CBO members with whom initial communication is made for improved water and sanitation services are not seen to be permanent due to the rapid rate of in-migration (Roy, personal communication, 9 August 2011). Issues of disorganisation within low-income communities as new migrants arrive is voiced (ibid). With the implication that DWASA experiences profit loss from unpaid bills, NGOs are now seen as needed to enforce timely payment (ibid). Moreover, with NGOs being the ‘main players’ in providing the SIM model, lack of NGO funding can halt progress (ibid). These issues combined with threat of forced eviction making the SIM model problematic in areas where land tenure is insecure, has led the CM to call for new international, national and local NGO research into sustainable WASH service delivery for low-income urban communities that will facilitate adaptation (ibid). This finding can be viewed as adaptation as transformation, as it acknowledges initial intent to change the structure of pro-poor service delivery within DWASA’s existing governance system (Pelling, 2011: 51).

This highlights the two barriers that DWASA perceive to hinder pro-poor service provision (Roy, personal communication, 9 August 2011); firstly, the question of land tenure security, which

34 This statement is based on information given by lecturer Mo Hamza during the MA in Development and Emergency Practice at Oxford Brookes.
respondents requested support with. Legal tenure is a prerequisite for the adequate provision of basic services (Payne et al., 2007), however addressing the issue of receiving basic services is politically challenging as government agencies must agree to and reach agreements with respondents over the transfer of land tenure (Moser and Satterthwaite, 2008: 10); adaptation as transformation. Rapidly increasing property prices (Huq, personal communication, 3 August 2011) and cost of land resulting from market forces and restrictive regulatory frameworks excludes respondents from obtaining legal access to land and shelter on ‘safe’ sites (Payne and Majale, 2004: 54). Key informant findings reveal that safe water and sanitation services for respondents is ultimately a question of political will – the most important element in implementing pro-poor regulatory reform from national to local level (ibid: 110). If this is lacking, initiatives to improve access to affordable basic services is virtually impossible (ibid).

The SIM model has provided legal water connections to informal settlements irrespective of land tenure issues as a result of changes made to the DWASA Citizen Charter following substantial donor/NGO advocacy (Shaheen, personal communication, 8 August 2011); adaptation as transition. Nevertheless, fieldwork findings show it is a key concern irrespective of changes in regulation. Advocacy for low-income community land tenure issues is therefore needed. Moreover, undertaking strategies to attempt to increase political will, such as capacity building within government agencies in conjunction with publicising research findings in popular media that demonstrates reforms are required and can be achieved are suggested (Payne and Majale, 2004: 110).

Examples of ‘good practice’ that have successfully addressed the needs of low-income urban communities at scale by facilitating land tenure and improved access to basic services provide possible lessons to learn from. Adopting a ‘twin-track’ approach towards existing and potential future informal settlements offers mechanisms to improve tenure security and support upgrading in existing settlements, while revising regulatory frameworks to increase the supply and reduce the cost of land for new housing (Payne, 2005: 135; Satterthwaite et al., 2005: 11).\footnote{Evidence suggests increasing short-term security for residents by widening the range of intermediate tenure options providing protection from forced eviction for 6-12 months, combined with undertaking regulatory audits of planning regulations, standards and administrative procedures as a means to work towards pro-poor regulatory reform (Payne, 2004: 55). Example of reforms needed to increase the supply and reduce the cost of land for housing include changing regulations that demand unnecessarily large minimum plot sizes, building setbacks and land for roads, and inappropriate floor-to-area ratios and maximum densities (Satterthwaite et al., 2005: 11). These example reforms are from a case-study in Phnom Penh, Cambodia.}
Likewise, examples of urban ‘co-production,’\textsuperscript{36} demonstrate capacity to work at scale at improving basic infrastructure services while changing the role of citizens in relation to the state (Mitlin, 2008). The Orangi Pilot Project (OPP) in Karachi, Pakistan illustrates informal settlement communities financing, managing and maintaining their own sanitation and drainage programme, while providing a participating role for local government who no longer had to pay for these components and hence were able to finance larger external truck sewers, drains and treatments plants into which the community sewers feed (Swalheim and Dodman, 2008). Rather than lobbying local government for services, as was the impetus for the SIM model due to substantial NGO advocacy, this project evolved by demonstrating a workable strategy from the bottom-up, which recognition of by local government facilitated political commitment. Project sustainability and scaling up is ensured by this long-term partnership between local government, the NGO supporting the implementation of localised actions and informal settlement inhabitants themselves – an essential partnership for climate change adaptation that ensures inclusiveness and low-income community participation (ibid).

This is important; by including citizens in the decision-making processes that affect them (Ayers, 2010) adaptive capacity will be enhanced by empowering the most vulnerable. The OPP cultivated low-income community innovation with the ownership of the process resting with residents themselves. In comparison, the SIM model has created a system that temporarily reduces the problem of lack of access to safe water supply, however it does not offer a sustainable solution due to the lack of promotion of local innovation (Akbar et al., 2007). NGOs provide an approach, rather than act as enablers facilitating a process. Nevertheless, the SIM model has forged the basis of a necessary partnership between local service providers and community-based organisations working with the urban poor that is essential in facilitating successful adaptation (Swalheim and Dodman, 2008), even if operational mechanisms within the partnership require change.

An analysis of further ‘co-production’ experiences of affiliates of Shack/Slum Dwellers International (SDI), an international network of community-based organizations of the urban poor,\textsuperscript{37} offers insight into what operational mechanisms provide successful service provision, offering potential lessons for Dhaka’s context (Mitlan, 2008: 350). These include design benefits - with the urban poor designing through experience, not through abstract conceptual models, it is more effective than lobbying the

\textsuperscript{36} ‘Co-production’ refers to the joint agreement and production of public services between citizen and state, with any one or more elements of the production process being shared (Mitlin, 2008: 340).

\textsuperscript{37} For further information, visit http://www.sdinet.org/
state for improvement in service provision because it enables real delivery problems to be considered by those who suffer the consequences of poor policies; *relational benefits* – by avoiding confrontation with the state, practical engagement builds stronger positive social relations and possible further opportunities for collaboration; *inclusive benefits* - emphasis on the practical and non-confrontational encourages women to play a central role in the local process, ensuring a collective entity through which disadvantaged groups can strategise to address their needs; and *empowerment and poverty reduction benefits* - engagement in this process has proved effective in encouraging those involved to gain confidence in their skills and capacities (ibid). Working towards development assistance that negotiates long-term partnerships involving multi-stakeholders (municipal government, NGOs, community-based organisations) that ensure inclusiveness and accountability instead of fixed term projects to achieve sustainable development goals is required.  

In response to the CM’s request of NGO research into sustainable service delivery provision, initiating communication channels facilitating networks between DWASA and international/national NGOs, research centres and international federations, such as SDI, is recommended. With SDI setting up ‘learning centres’ throughout the world from 2011 to demonstrate people-led solutions to urban development challenges that have gone large scale within individual cities, the potential for cross-learning is invaluable.

Secondly, the issue of in-migration is raised. Key informant findings suggest incentivising migrants to locate to alternate urban areas by decentralising Dhaka’s facilities and developing other cities (Nazeem, personal communication, 14 August 2011). This calls for businesses and GoB to adapt. Moreover, investing in infrastructure in order to connect safe new inhabitable land to Dhaka is stated (ibid). By facilitating access to employment activities with housing potentially on safer sights, this recommendation works towards keeping Dhaka’s current water body in tact while providing low-income communities with greater protection.

### 4.5 Filling in the gaps from community to national level

To further reduce the existing adaptation deficit, supporting respondents with their request for knowledge on expected climatic impacts and how to adjust their WASH and livelihood practice to

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38 This statement is based on information given by lecturer Mo Hamza during the MA in Development and Emergency Practice at Oxford Brookes.

39 For further information, visit http://www.sdinet.org/upfi/
these impacts is needed.\textsuperscript{40} This request highlights issues of modernity; respondents may not know how to adapt due to lack of knowledge transfer between generations and/or indigenous knowledge not fitting the urban picture.\textsuperscript{41} As information becomes knowledge when people can understand and use it (Levine et al., 2011: 46), information on climatic impacts is to be given in a language and format easily accessible to all respondents (Huq, 2008) combined with giving respondents tools to find information for themselves (Levine et al., 2011: 8). By empowering respondents to make more informed decision-making, rather than being recipients of facts, enhanced adaptive capacity to climate variability and future climate change impacts is likely (ibid). Moreover, as previously discussed, it is important that information given is based on the analysis of local climatic data spanning over the next 30 years to promote sustainability in line with potential climate change impacts. Building prepared communities through education and training that understand and know what to do to protect itself and recover from climate variability and climate change impacts on water supply, sanitation and hygiene issues is recommended.\textsuperscript{42}

Likewise, respondents requested support with access to healthcare, as current access is considered insufficient. With unsafe WASH practice causing heavy health burdens on respondents and consequently increased debt burdens from undertaking loans to cover costs, access to affordable healthcare and healthcare that incorporates issues relating to climate variability and climate change is needed (Rabbani et al., 2011).

Effective adaptation at community level requires a strengthened planning and implementation process involving institutional support at municipal and national level (Heath et al., 2010: 8). Local government institutions control services and infrastructure (Swalheim and Dodman, 2008) while functioning as implementing agencies of policies determined at national level (Raihan, et al., 2010: 73). Mainstreaming\textsuperscript{43} climate change into the WASH sector and sub-sector documents and plans is

\textsuperscript{40} This was not covered under the scope of the WSUP project.

\textsuperscript{41} This statement is based on information given by lecturer Mo Hamza during the MA in Development and Emergency Practice at Oxford Brookes.

\textsuperscript{42} ibid.

\textsuperscript{43} Mainstreaming climate change into the water and sanitation sector means integrating climate change into ongoing development planning to “climate proof” existing development investments, maximize the potential of development projects to enhance adaptive capacity, and avoid maladaptation (Ayers, 2009: 232). As stated in chapter 1, maladaptations are actions or investments that enhance rather than reduce vulnerability to climate change impacts (ibid). Mainstreaming is seen as making more sustainable, effective and efficient use of resources than is the case when climate policies are designed and managed separately from ongoing activities (ibid: 233).
therefore needed to address existing policy gaps (Rahman, 2009). Moreover, climate change impacts on urban poor WASH needs to be mainstreamed across sectoral planning processing, as climate change may adversely affect inter-linking sectors, including health and education (Rabbani, 2011). The Bangladesh Country Disaster Management Programme illustrates how GoB has sought to mainstream climate change into development projects at country, sector and community level, however there is limited evidence how specific WASH initiatives have been developed and implemented (Calow et al., 2011: 38). Potential climate change impacts on WASH are specified in the recently released Sector Development Plan (GoB, 2011), however articulated actions to assist the urban poor with these impacts are also limited. Likewise, climate change policy focusing on the specific needs of the urban poor is needed (Roy, 2011). The Bangladesh Climate Change Strategy and Action Plan (BCCSAP) (GoB, 2009)\(^{44}\) acknowledges the impact of climate change on urban areas, however it does not articulate what action needs to be taken to assist the urban poor (ibid).

Furthermore, there is still no specific GoB policy focusing on urban issues and the urban poor (Rahman, personal communication, 28 July 2011). Key informant findings show a range of reasons for this; from misconceptions regarding the dynamics of urban poverty in general among policy makers; a lack of awareness within GoB of climate change impacts on urban areas; to GoB being aware of climate-urban issues but possessing a lack of understanding of how to tackle urban complexity (Huq, personal communication, 3 August 2011). Advocacy and institutional capacity building to focus policy needs on the urban poor and WASH issues at national and municipal level is needed, with NGOs to play a vital role in facilitation (Rabbani, 2011). As donors are well positioned to facilitate the mainstreaming of climate change into national development plans by working through the existing channels of multilateral and bilateral assistance to build the capacity for integrating climate considerations across institutions, facilitating this action is recommended (Ayers and Huq, 2008). Moreover, raising awareness of WASH/climate change/urban poor issues can be facilitated by forming networks/forums with multi-stakeholders (NGOs/CBOs/climate experts) to generate understanding (ibid).

Facilitating good governance for urban adaptation has to be combined with appropriate funding flows; one cannot work without the other (Swalheim and Dodman, 2008). Respondent access to

\(^{44}\) The BCCSAP was developed after the 2005 National Adaptation Programmes of Action (NAPA) based on GoB support for addressing climate change. NAPA is a process for Least Developed Countries (LDCs) to identify priority activities in response to meeting their urgent and immediate needs for adapting to climate change. For further information: [http://unfccc.int/national_reports/napa/items/2719.php](http://unfccc.int/national_reports/napa/items/2719.php).
legal water supply is dependent on donor fiscal support reaching local level, making managing capital costs due to shortage of international and national funding a major issue of the SIM model (Akbar et al., 2007: 29). Without adequate resources, granting access to legal water supply aiding respondent adaptation cannot be facilitated. As access to safe water supply is a political issue, making funding available for adaptation activities that address non-climatic aspects of vulnerability is needed (Ayers, 2009: 231).

Moreover, to ensure municipal government and community organisations are able to support local adaptation, ensuring funding for adaptation needs reaches those best able to use it at local level is necessary (Swalheim and Dodman, 2008). Formulating multi-stakeholder partnerships to attract funding is therefore needed (Mitlan, 2008), as is strengthening municipal government capacity and accountability to reduce gaps between local and national processes (Ayers, 2009). Likewise, directing funding towards the needs of the urban poor across scales is needed; what adaptation funding has been supported gives little attention to urban areas (ibid). Funding for adaptation needs in Bangladesh is soon to be disbursed through its own country-owned Bangladesh Climate Resilience Fund that will implement actions stipulated in the BCCSAP (Rabbani et al. 2011). A water and sanitation programme for climate vulnerable areas is stated, though urban areas are not specifically mentioned, as is urban drainage improvement, which includes Dhaka; however, as stated, actions articulating what needs to be taken to assist the urban poor is lacking (Roy, 2011). Supporting research into mechanisms that facilitate increased access to funding for urban poor adaptation is needed (Ayers, 2009).

Furthermore, at national level, in conjunction with advocacy, donors require training to ensure recognition of climate change adaptation proposals to facilitate funding allocation (Huq, personal communication, 11 July 2011). To secure adaptation funding, presenting additional information that is ‘extra’ to development makes proposals climate change adaptation specific. This additional information includes intervention justification based on climate projections (ibid).

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45 Actions stated are (i) monitor changes in water quality and quantity available for drinking and forecast future changes due to climate change and (ii) plan for and invest in additional water supply and sanitation facilities (GoB, 2009: 59).

46 Actions stated are to include (i) assess the drainage capacity of major cities and investigate structural and non-causes of water-logging within cities and their immediate surroundings using hydro-dynamic models; (ii) design and invest in improvements in the drainage capacity of major cities and selected towns.
In addition, to build respondents’ adaptive capacity to future climate change impacts, assisting donor ability to increase funding and agency competency to address the backlog in Dhaka’s urban water, sanitation and drainage infrastructure is needed (Moser and Satterthwaite, 2008). Moreover, investing in climate proofing infrastructure to ensure sustainability is required. If city-wide trunk infrastructure is vulnerable to climate change risk, so will respondents.

To ensure sustainability in to water supply in a context of existing water constraints and potential future climate change impacts, integrated water-resource management plus adaptive responses on both supply and demand sides is needed (Satterthwaite et al., 2007: 57). Key informant findings show that DWASA is implementing initiatives to change water availability to address increasing demand, as well as to shift from increased reliance on groundwater from current rates of 87% to 40% by 2020. Moreover, with DWASA management focusing on climate change impacts on drainage and sewage, news plans to address this requirement is underway (Liakath, personal communication, 21 August 2011). Even so, the above discussion on institutional capacity building to transition understanding of adaptation from current status to future climate change is relevant.

Furthermore, additional adaptation measures to investigate include increasing the water-absorbing capacity of Dhaka due to increased concrete development on flood plains increasing existing flood risk (Satterthwaite et al., 2007: 57); supporting construction of flood reservoirs in river basins surrounding Dhaka to reduce flood risk (Rabbani et al., 2011: 539); enforcing water regulation extraction policy to support declining groundwater levels; and land-use planning and zoning to avoid locating people and buildings in unsafe areas prone to flooding (Satterthwaite et al., 2007: 57).
Chapter 5: Conclusion
5. Conclusion

5.1 Adaptation recommendations to build the adaptive capacity of low-income inhabitants in Dhaka to the potential impacts of climate change on WASH practice

This dissertation has advocated that adaptation to climate change impacts on WASH practice for low-income inhabitants in Dhaka is a social, political, cultural and technological process (Pelling, 2011). Underlying causes of respondent risk due to lack of access and equity to water supply is social and political; water security is not environmentally determined but is the result of ineffective urban governance emanating from poor institutional capacity underpinned by issues of social marginalisation (Satterthwaite et al., 2007).

Respondents are not vulnerable therefore by the potential hazard of climatic factors on WASH practice itself, but by the social and political factors that make them vulnerable to the potential hazard in the first place (Ayers, 2010: 77). As there are no disasters without a vulnerable population (Satterthwaite et al., 2007), effective adaptation measures that build respondent adaptive capacity by addressing the underlying social root causes of vulnerability in conjunction with appropriate climate-proofed interventions that address local climate change impacts are required if potential substantial human health impacts are not to result.

To these ends, adaptation measures to build respondent adaptive capacity to climate change impacts on WASH practice are needed across scales; at community, municipal and national level (Bartlett et al., 2008). Effective adaptation at community level requires a strengthened planning and implementation process involving institutional support above (Heath et al., 2010: 8). Many strategies are likely to be successful if supported by services and infrastructure controlled by local government (Swalheim and Dodman, 2008: 2). Adaptation therefore does not happen in isolation, but in an institutionally rich context (Agrawal, 2010). Similarly, local government institutions operate in a national political and institutional context, and function as implementing agencies of policies determined at national level (Raihan, et al., 2010: 73). Adaptation interventions incorporating institutional scope from community to national scale is therefore needed.

Moreover, to gauge an understanding of adaptation intentions and goals across scales, Pelling’s (2011) resilience-transition-transformation framework can be employed. This dissertation has supported the notion that for respondents to build flexible adaptive capacity in the face of
unexpected and predicted hazards, vulnerabilities and their impacts (Pelling, 2011: 58), adaptation measures are required that address the symptoms and causes of risk. With underlying social root causes of risk leveraging transformational change, incorporating adaptation measures that ideally work towards this goal is key.

Based on fieldwork and literature review findings, the following adaptation recommendations to build the adaptive capacity of low-income inhabitants to climate change impacts on WASH practice are presented.

5.1.1 Community level:
1. The WSUP project in operation at the time of research that focused on providing safe water and sanitation to low-income inhabitants, may potentially generate maladaptation through the construction of WASH infrastructure based on respondent input of past flood levels. As future climate change impacts cannot be predicted hence past observed data is not indicative of the future, enabling sustainability of investment to likely future climate change impacts at local level is needed. To address this, **NGOs/ development actors working at project level are required to work with the Bangladesh Meteorological Centre to analyse local climatic data spanning over the next 30 years to gauge an understanding of what possible impacts might be and hence what response is likely to be required** (Huq, personal communication, 3 August 2011). This *adaptation as resilience* to avoid maladaptation is identified as making development assistance adaptive to future climate change risk, compared to development ‘business as usual’ that does not take potential climate change impacts into account, or disaster risk management measures aimed at addressing current climate variability impacts. Following on, this highlights the need for **capacity building of development project planners and managers to ensure integration of risk reduction and climate change adaptation** in development programmes (Ayers and Huq, 2008), and that the difference between these levels of adaptation is understood so the above knowledge and information can be disseminated in support of adaptation activities that build respondents’ adaptive capacity (Levine et al., 2011).

2. Respondents requested support with understanding potential climatic impacts on WASH practice and how to adapt to these impacts. To address this, **building prepared communities through education and training that understand and know what to do to protect itself and recover from climate variability and climate change impacts on water supply, sanitation and hygiene issues** is needed. This *adaptation as resilience* aims to maintain functional persistence in a changing
environment by empowering respondents to make more informed decision-making about the adaptation activities they undertake, hence enhancing their adaptive capacity through knowledge and information (Levine et al., 2011). To facilitate this action, the following is suggested:

- Present information in a language and format easily accessible to respondents (Huq, 2008).
- Give respondents tools to find information for themselves (Levine et al., 2011: 8).
- Provide information based on the analysis of local climatic data spanning over the next 30 years to promote sustainability in line with potential climate change impacts.

3. With climatic impacts on WASH practice exacerbating ill-health, respondents requested support with access to healthcare, as current access is insufficient. To address this, increasing access to appropriate and affordable healthcare services for low-income communities that incorporates climate variability and climate change issues is needed (Rabbani et al., 2011). This adaptation as transition will build respondents’ adaptive capacity by implementing responsibilities towards respondents that allows fair access to key assets (Levine et al., 2011). In an era of climate change, health services need to incorporate an understanding of health concerns that may arise as a result of climate variability and climate change impacts, and for access to ideally be available outside of respondent working hours. Following on, this highlights the need for sustainable development packages that incorporate WASH, health, climate change and infrastructure.

4. Respondents requested support with drainage provision to reduce flood risk that exacerbates ill-health and an inability to generate income. To address this, investing in community-based climate-proofed drainage provision that links to city-wide (climate-proofed) drainage systems is required; adaptation as resilience. Community-based drains need to be supported by city-wide trunk infrastructure that respondents alone cannot install (Satterthwaite et al., 2007: 63). Moreover, assessing local climatic data spanning over the next 30 years is needed to climate-proof infrastructure.

To facilitate this action and to ensure intervention sustainability, working towards development assistance that negotiates long-term partnerships involving multi-stakeholders (e.g. local government/NGOs/respondents) to achieve sustainable development goals is needed; adaptation as transition. Moreover, promoting such multi-stakeholder partnerships is likely to channel increased funding flows for WASH activities, as shall be discussed below (Mitlin, 2008).
5. With issues regarding social marginalisation inhibiting equity and access to safe water and sanitation services for respondents, the WSUP project started to initiate institutional change within DWASA (and DCC). Building institutional capacity is a long-term process, however the WSUP project is for a fixed time period. To address this, **long-term commitment from development assistance is required rather than fixed term projects.** This **adaptation as transition** is needed to facilitate DWASA (and DCC's) responsibility of providing water and sanitation services to respondents. However, it holds the potential for **adaptation as transformation** if capacity building leverages governance reform over time. Following on, this highlights the need for **sustainable development packages that target the symptoms and causes of respondent risk by encouraging WASH practitioners to move beyond technical fixes to broader strategies aimed at non-climatic risk factors regarding equity and access.**

**5.1.2 Municipal level:**

1. Respondents’ lack of land tenure inhibits DWASA in facilitating pro-poor access to safe water and sanitation services. To address this, **advocacy to facilitate policy changes regarding low-income inhabitant land tenure** is needed. This action holds potential for **adaptation as transformation** as secure land tenure would redistribute respondent security and opportunity within society (Pelling, 2011). Enabling land tenure security would allow fair access and entitlement to a key asset that would build adaptive capacity by allowing respondents to better respond to evolving environmental circumstances (Levine et al., 2011).

To support this action, adopting a ‘twin-track’ approach towards existing and potential future informal settlements may be plausible. This offers mechanisms to improve tenure security and support upgrading in existing settlements in the short-term, while revising regulatory frameworks to increase the supply and reduce the cost of land for new housing long-term (Payne, 2005). Similarly, undertaking strategies to attempt to increase political will, such as capacity building within government agencies in conjunction with publicising research findings in popular media that demonstrates reforms are required and can be achieved are suggested (Payne and Majale, 2004: 110).

2. Further institutional barriers and operational malpractice within DWASA (and DCC) inhibits respondent access to safe water and sanitation services. To address this, **building the capacity of DWASA (and DCC) to facilitate pro-poor service provision** is needed; **adaptation as transition** that
holds the potential for *transformational change*. An institutional environment that allows access to key assets by implementing its responsibility will build respondents’ adaptive capacity, as will an institution that is able to anticipate, incorporate and respond to changes with regard to future planning and its governance structures (Levine et al., 2011). To work towards facilitating this action, the following is suggested:

- Increase competency and co-ordination between DWASA and DCC on urban poor services
- Review DWASA and DCC policies and plans to assess integration of risk reduction and climate change adaptation (including the urban poor) and aid support as required incorporating understanding of the need to analyse local climatic data spanning over the next 30 years
- Initiate an adaptation programme for ‘emergency’ periods at DWASA and DCC that includes the urban poor
- Sensitize key decision-makers at DWASA and DCC to climate change-WASH-urban poor issues and introduce a Climate Change Research Cell with trained staff at DWASA and DCC to support research on climate change impacts on WASH practice in low-income urban areas and possible responses
- Strengthen inclusiveness by enabling DWASA to assert its policy of an equitable water service by building capacity of its ‘Low-income Community Cell’
  - Increase funding allocation
  - Increase trained manpower with clear understanding of roles and responsibilities to ensure functional effectiveness
  - Incentivise staff to reduce illegal connections (CBSG, 2010)
  - Introduce a Low-income Community cell into each zonal office in Dhaka
  - Set-up a Low-income Community Services Support Cell at DWASA headquarters (ibid)
  - Review alternative tariff structures for different consumer groups (ibid)
  - Introduce regulatory measures that safeguard low-income communities from monopolistic water-pricing from private water distributors (ibid)
  - Instigate an action learning programme to understand urban sanitation and hygiene behaviour so appropriate plans for sanitation and hygiene promotion can be initiated (ibid)
  - Sensitize DWASA management to Low-income Community Cell operations to ensure recognition and support
3. DWASA’s Commercial Manager requested for new international, national and local NGO research into sustainable WASH service delivery mechanisms for respondents that will facilitate adaptation, as the current SIM model\(^{47}\) in operation for providing low-income inhabitants with water supply is viewed as unsustainable long-term. To address this, *initiating a research cell with trained staff within DWASA’s Low-income Community Cell on alternative sustainable service delivery mechanisms for low-income communities and supporting communication channels between this research cell and national and international NGOs/research centres/international federations working for the urban poor to enable knowledge sharing* is needed. This action holds potential for *adaptation as transformation* as it acknowledges initial desire to change the structure of pro-poor service delivery within DWASA’s existing governance system.

Based on the limitations of the SIM model, the following points offer potential lessons to be learnt for Dhaka’s context from examples of co-production\(^ {48}\) good practice exemplified in alternative global urban informal settlement locations with similarities between political economy contexts:

- For the urban poor to design a service delivery mechanism through experience, not through abstract conceptual models, to enable delivery problems to be considered by those who suffer the consequences of poor policies (Mitlan, 2008). Facilitating such an environment will consequently promote local innovation and a process that is owned by low-income inhabitants themselves, rather than by NGOs who currently provide respondents with water supply via the SIM model instead of facilitating a bottom-up process that fosters innovation and empowerment (Akbar, 2007).

- To undertake practical engagement with the state, rather than confrontation, to build stronger positive social relations and possible further opportunities for collaboration (Mitlan, 2008).

- To encourage women to play a central role in the process, ensuring a collective entity through which disadvantaged groups can strategise to address their needs (ibid).

As previously stated, *working towards development assistance that negotiates long-term partnerships involving multi-stakeholders that ensure low-income community inclusiveness and*...

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\(^{47}\) This service delivery model was initiated by NGOs WaterAid Bangladesh and its local partners DSK (Dustha Shastha Kendra) and PTSC (Population Services and Training Centre) in 1992 (Akbar, 2007).

\(^{48}\) Co-production’ refers to the joint agreement and production of public services between citizen and state, with any one or more elements of the production process being shared (Mitlin, 2008: 340).
accountability instead of fixed term projects to facilitate sustainable development is needed in order to build flexible respondent adaptive capacity.

4. In order for NGOs/development actors at community level, and for DWASA and DCC to develop adaptation plans and policies that aim to address future climate change impacts on WASH practice at local scale, facilitating scientific and technical capacity to enable downscaling of climate models that produce relevant, credible and practically useful information in order to inform development policies and plans is required (Ayers and Huq, 2008). Moreover, strengthening capacity to monitor existing climate variability impacts on water resources at local level is also needed (Calow et al., 2011: 36). This adaptation as resilience to facilitate functional persistence, will build respondents’ adaptive capacity through the collection, analysis and dissemination of knowledge to support respondent adaptation activities (Levine et al., 2011). To support this action, the following is suggested:

- Awareness raising of local climate information within DWASA, DCC, NGOs/other development actors to ensure its use among development actors and practitioners (Ayers and Huq, 2008)
- For the information to be presented in a format applicable to practical action by different stakeholders, including policy makers, planners, civil society organisations and research communities (ibid).

5. To support drainage provision to reduce respondent flood risk at community level, strengthening existing drainage trunk infrastructure is needed, and for strengthened infrastructure to be climate-proofed based on the analysis of local climatic data spanning over the next 30 years; adaptation as resilience. To facilitate this action, leveraging funding flows through national budgetary allocations is required (UN-Water, 2010b). To support this, strengthening municipal government capacity and accountability to reduce gaps between local and national processes to ensure funding reaches those best able to use it is needed (Ayers 2009); adaptation as transition.

6. Additional adaptation measures to investigate at municipal level that would contribute to reducing respondent vulnerability to climatic impacts on WASH practice include, increasing the water-absorbing capacity of Dhaka due to increased concrete development on flood plains increasing existing flood risk (Satterthwaite et al., 2007: 57); supporting construction of flood reservoirs in river basins surrounding Dhaka to reduce flood risk (Rabbani et al., 2011: 539); enforcing water regulation extraction policy to support declining groundwater levels (Rahman,
and enforcing land-use planning and zoning to avoid locating people and buildings in unsafe areas prone to flooding (Satterthwaite et al., 2007: 57). These measures combine adaptation as resilience and adaptation as transition by relating to changes in technology, management practice and organisation, as well as changes in governance practice.

5.1.3 National level:

1. Facilitating WASH adaptation measures at community and municipal level cannot take place without adequate funding. Funding for adaptation needs is soon to be disbursed through the Bangladesh Climate Resilience Fund that will implement actions stipulated in the BCCSAP (Rabbani et al. 2011). However, articulated actions within the BCCSAP to assist the urban poor (Roy, 2011) and urban poor WASH issues are lacking. To address this, raising awareness of donors to target funding to urban poor WASH adaptation needs in order to leverage funding flows through national budgetary allocations, and to initiate donor training to ensure recognition of climate change WASH adaptation proposals for funding allocation are required. Moreover, supporting research into innovative mechanisms that facilitate increased access to funding for urban poor WASH adaptation is needed (Ayers, 2009: 231). Furthermore, as respondent access to safe water supply is a social and political issue, making funding available for adaptation activities that address non-climatic aspects of vulnerability is recommended (ibid). With funding required to operate any planned adaptation measure, these actions can be viewed as holding the potential for adaptation as resilience, transition or transformation depending on the intent of the adaptation measure itself.

2. With lack of policy focus on urban poor-WASH-climate change issues, sensitising key decision-makers across sectors to urban poor-WASH-climate change issues is needed. This can be facilitated by undertaking advocacy to support mainstreaming of urban poor-WASH-climate change adaptation into all national, sub-national, sectoral and spatial planning processes (Rabbani, 2011). Moreover, raising awareness of urban poor-WASH-climate change issues can be facilitated by forming networks/forums with multi-stakeholders (NGOs/CBOs/climate experts) to generate understanding (ibid) and by actively engaging with the recently established Dhaka-based Bangladesh Urban Forum. As these actions advocate for potential changes in the existing governance system, they can be viewed as adaptation as transition.

49 The first Bangladesh Urban Forum (BUF) was held from 30 October to 1 November 2011. Its purpose is to build consensus on the problems of and possible responses to rapid urbanization, with particular focus on urban poverty and urban governance (BUF, 2011: 2).
3. To support strengthening and climate-proofing of drainage infrastructure at municipal level, assisting donor ability to increase funding and agency competency to address backlog in drainage (and water and sanitation) infrastructure is required (Moser and Satterthwaite, 2008); adaptation as resilience.

4. Rapid migrant in-migration poses a major challenge for DWASA in facilitating sustainable pro-poor service provision. To address this, and to support Dhaka’s diminishing water body, incentivising migrants to locate to alternate urban areas by decentralising Dhaka’s facilities and developing other cities is suggested. Similarly, investing in infrastructure to connect safe habitable land to Dhaka with access to low-income community employment opportunities is also recommended; adaptation as resilience as these actions relate to maintaining functional persistence in a changing environment.
Appendices
Appendix 1: Well-being Ranking

CARE-Bangladesh/WSUP project criteria of well-being ranking for respondents

**Extreme poor**
Monthly household income TK. 0 - 4000/=  
Non-homeowners  
Increased number of family members  
Irregular income  
Children deprived of education  
Children involved with income generating activities  
Don’t consume three meals per day for most of the year

**Ultra poor**
Monthly household income TK. 4001-6000/=  
Non-homeowners  
Increased number of family members  
Regular income  
Earnings dependent on one person in the family  
Increased number of family members  
Children deprived of education  
Children involved with income generating activities  
Don’t consume three meals per day for most of the year

**Poor**
Monthly household income TK. 6001-10,000/=  
Homeowners  
Increased number of people earning in the family  
Children deprived of education  
Need loans for healthcare purposes  
No savings  
Difficult to meet three times per day food requirement

**Lower middle class**
Monthly household income upper than TK. 10,000/=  
Homeowners  
Can meet three times per day food requirement  
Children attend primary school  
Can afford healthcare  
Few savings

The above well-being ranking categories were decided upon by respondents themselves in response to fieldwork undertaken prior to this study by the same CARE-Bangladesh field team used by the author in order to establish socio-economic status of households. Well-being ranking is based upon combined income levels of household members.
## Appendix 2: Key Informant Interviews

All interviews took place in person in Dhaka, Bangladesh between 3 August and 21 August 2011.

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Affiliation</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahmad, Emaduddin</td>
<td>Team Leader, Mathematical Modelling for Safe Drinking Water Source Identification</td>
<td>DPHE</td>
<td>August 14 2011</td>
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<tr>
<td>Ali, Dr. Liakath</td>
<td>Deputy Managing Director</td>
<td>DWASA</td>
<td>August 21 2011</td>
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<tr>
<td>Banik, Amar Chan</td>
<td>Zonal Executive Officer</td>
<td>DCC</td>
<td>August 18 2011</td>
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<tr>
<td>Choudhury, Giasuddin Ahmed</td>
<td>Executive Director</td>
<td>CEGIS</td>
<td>August 17 2011</td>
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<tr>
<td>Haque, Begum Meherunnessa</td>
<td>Ward Commissioner</td>
<td>DCC</td>
<td>August 18 2011</td>
</tr>
<tr>
<td>Huq, Dr. Saleem</td>
<td>Director</td>
<td>ICCCAD</td>
<td>August 3 2011</td>
</tr>
<tr>
<td>Islam, Professor Nazrul</td>
<td>Chairman</td>
<td>CUS</td>
<td>August 16 2011</td>
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<tr>
<td>Islam, Rabiul</td>
<td>Senior Specialist, Water Supply &amp; Sanitation</td>
<td>DPHE</td>
<td>August 14 2011</td>
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<tr>
<td>Islam, Shahidul</td>
<td>Project Manager</td>
<td>WSUP</td>
<td>August 10 2011</td>
</tr>
<tr>
<td>Islam, Tarik-Ul</td>
<td>Assistant Country Director, Environment Energy &amp; Climate Mitigation</td>
<td>UNDP</td>
<td>August 16 2011</td>
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<tr>
<td>Kabir, Ahammadul</td>
<td>Chief, Arsenic Cell (in the process of being appointed Chief, Climate Change Cell)</td>
<td>NGO Forum for Drinking Water Supply and Sanitation</td>
<td>August 17 2011</td>
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<td>Kabir, Babir</td>
<td>Director, Disaster Environment and Climate Change, and Water Sanitation and Hygiene</td>
<td>BRAC</td>
<td>August 9 2011</td>
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<td>Kabir, Dr. Quazzi Alamgir</td>
<td>Chief, Research Cell</td>
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<td>Khan, Malik Fida</td>
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<td>CEGIS</td>
<td>August 17 2011</td>
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<td>WSUP</td>
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<td>22</td>
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<td>Head, Matlab Health and Demographic</td>
<td>ICDDR, B</td>
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</table>


Appendix 3: Glossary of Terms

All definitions are from Bates et al., 2008, except where recorded.

Global warming: Global warming refers to the gradual increase, observed or projected, in global average surface temperature, as one of the consequences of radiative forcing caused by anthropogenic emissions.

Climate change: a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

Climate change impacts: the effects of climate change on natural and human systems. Depending on the consideration of adaptation, one can distinguish between potential impacts and residual impacts. Potential impacts: all impacts that may occur given a projected change in climate, without considering adaptation. Residual impacts: the impacts of climate change that would occur after adaptation.

Climate variability: variabilities in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variabilities in natural or anthropogenic external forcing (external variability).

Vulnerability to climate change: the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.

Adaptive capacity:
A. The whole of capabilities, resources and institutions of a country or region to implement effective adaptation measures.
B. The inherent or existing ability of a community, institution or country to cope with climate impacts (Huq and Reid, 2009: 315).
**Adaptation:**

**A.** In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate (IPCC, 2011).

**B.** Preparing for and coping with climate impacts (Swalheim and Dodman, 2008).

**Mitigation:** technological change and substitution that reduce resource inputs and emissions per unit of output. Although several social, economic and technological policies would produce an emission reduction, with respect to climate change, mitigation means implementing policies to reduce greenhouse gas emissions and enhance sinks.

**Resilience:**

**A.** The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions (IPCC, 2011).

**B.** A refinement of actions to improve performance without changing guiding assumptions or the questioning of established routines, such as the application of resilient building practices or new seed varieties. (Pelling, 2011: 23).

**Projection:** a potential future evolution of a quantity or set of quantities, often computed with the aid of a model. Projections are distinguished from predictions in order to emphasise that projections involve assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realized, and are therefore subject to substantial uncertainty.

**Scenario:** a plausible and often simplified description of how the future may develop based on a coherent and internally consistent set of assumptions about driving forces and key relationships. Scenarios may be derived from projections, but are often based on additional information from other sources, sometimes combined with a narrative storyline.

**Sensitivity:** the degree to which a system is affected, either adversely or beneficially, by climate variability or climate change. The effect may be direct (e.g. a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g. damages caused by an
increase in the frequency of coastal flooding due to sea level rise).

**Climate**: usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. The relevant quantities are most often surface variables such as temperature, precipitation and wind. Climate in a wider sense is the state, including a statistical description of the climate system.

**Climate projection**: a projection of the response of the climate system to emissions or concentration scenarios of greenhouse gases and aerosols, or radioactive forcing scenarios, often based upon simulations by climate models. Climate projections are distinguished from climate predictions in order to emphasize that climate projections depend upon the emission/concentration/radioactive forcing scenario used, which are based on assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realized and are therefore subject to substantial uncertainty.

**Climate system**: a highly complex system consisting of five major components: the atmosphere, the hydrosphere, the cryosphere, the land surface and the biosphere, and the interactions between them. The climate system evolves in time under the influence of its own internal dynamics and because of external forces such as volcanic eruptions, solar variabilities and anthropogenic forces such as the changing composition of the atmosphere and land-use change.

**Greenhouse gas (GHG)**: gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth’s surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapor (H2O), carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4) and ozone (O3) are the primary greenhouse gases in the Earth’s atmosphere. Moreover, there are a number of entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine and bromine containing substances, dealt with under the Montreal Protocol. Beside CO2, N2O and CH4, the Kyoto Protocol deals with the greenhouse gases sulphur hexafluoride (SF6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).
Appendix 4: WSUP/ CARE-Bangladesh Project

**Project Duration:**

June 1, 2010 to December 31, 2011

**Project Location:**

Mirpur, Dhaka, Bangladesh

**Target Population:**

Low-income community inhabitants - 1000 households

**Project Goal:**

To reduce the vulnerability of 5000 marginalised informal settlement dwellers in Mirpur, Dhaka City, through improving access to safe water and hygienic latrines.

The ultimate goal is to contribute towards achieving MDG target 7c - halving the proportion of Bangladeshis without access to clean drinking water and basic sanitation.

**Project Objectives:**

- To increase accessibility of safe water and hygienic latrine for 500 household of Kalshibalur Math informal settlement, Mirpur, Dhaka city
- Increased awareness of 5000 community people regarding health and hygiene issues and improve hygiene behaviour of poor and vulnerable communities
- To build capacity of existing Community Based Organizations (CBOs) with planning community WASH demands and sustainable management of water sanitation facilities
- To explore and develop linkages to create opportunities for income generating options for the community

**Major Activities:**

- Strengthen community capacity to design water and sanitation facilities
- Capacity Building of CBO
• Hygiene Promotion at identified school in Mirpur - “Lifebuoy School of Five” Program
• Develop a partnership between DCC, WSUP and the Lifebuoy Campaign for scaling up of city wide hygiene promotion
• Formation of a zone level WASH steering committee in Mirpur with representatives from DWASA, DCC, civil society and representatives from user groups
• Support DCC in developing a comprehensive sanitation plan for Mirpur zone
• Provide support to DWASA to form a low-income community unit, coordinating with World Bank as appropriate
Appendix 5: Sample Household Questionnaire

1. Household Information

1.1 Name: …………………………………………………………………………

1.2 Age: ………………………

1.3 Male / Female

1.4 Marital status: …………………………………………………………………

1.5 Occupation: …………………………………………………………………

1.6 Household members: ……………………………………………………………

1.7 Education level: Iliterate / 1 to 5 / 6 to 10 / 10+ 

1.8 How long have you lived here? …………………………………………..

1.9 Why did you come to live here? ……………………………………………………

2. Water Information

2.1 a) What is the main source of drinking water for members of your household?

<table>
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<tr>
<th>Source of Drinking Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piped water into your house</td>
</tr>
<tr>
<td>Piped water into area next to your house</td>
</tr>
<tr>
<td>Public tap/standpipe</td>
</tr>
<tr>
<td>Tubewell/borehole</td>
</tr>
<tr>
<td>Protected dug well</td>
</tr>
<tr>
<td>Unprotected dug well</td>
</tr>
<tr>
<td>Rainwater collection</td>
</tr>
<tr>
<td>Bottled water</td>
</tr>
<tr>
<td>Cart with small tank</td>
</tr>
<tr>
<td>Surface water</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>

2.1 b) What is the main source of water used by your household for other purposes, eg hand washing, cooking?

<table>
<thead>
<tr>
<th>Source of Water for Other Purposes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piped water into your house</td>
</tr>
<tr>
<td>Piped water into area next to your house</td>
</tr>
<tr>
<td>Public tap/standpipe</td>
</tr>
<tr>
<td>Tubewell/borehole</td>
</tr>
<tr>
<td>Protected dug well</td>
</tr>
<tr>
<td>Unprotected dug well</td>
</tr>
<tr>
<td>Rainwater collection</td>
</tr>
<tr>
<td>Bottled water</td>
</tr>
<tr>
<td>Cart with small tank</td>
</tr>
<tr>
<td>Surface water</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>

2.2 How long does it take to go to water source, get water and come back? No. of minutes ……………………………

2.3 Who usually goes to this source to collect for your household?

<table>
<thead>
<tr>
<th>Role</th>
<th>Adult woman</th>
<th>Adult man</th>
<th>Female child (under 15 yrs)</th>
<th>Male child (under 15 yrs)</th>
</tr>
</thead>
</table>

2.4 How far do they go to collect drinking water? ………………………

2.5 How long does it take? ………………………

2.6 How far do they go to collect domestic water? ………………………

2.7 How long does it take? ………………………

2.8 Do you store water at home? Yes No If yes, how? ………………………

2.9 Do you treat your water in any way to make it safer to drink? Yes No

2.10 What do you do to the water to make it safer to drink? Boil Add bleach Use a water filter

Other ………………………

95
3. Sanitation Information

3.1 What kind of toilet facility do members of your household use?

<table>
<thead>
<tr>
<th>Flush/pour flush to:</th>
<th>piped sewer system</th>
<th>septic tank</th>
<th>pit latrine</th>
<th>unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pit latrine with slab</td>
<td>pit latrine without slab</td>
<td>composting toilet</td>
<td>bucket</td>
<td>hanging latrine</td>
</tr>
</tbody>
</table>

3.2 Do you share this facility with other households?  Yes  No  3.4 How many households? ...........................

4. Hygiene Information

4.1 What do you use for hand washing?  Soap  Ash  Nothing  Other...........................................

4.2 When do you wash your hands?  After toilet  Before preparing food  Before eating  Other.....................

4.3 Have you been taught about hygiene?  Yes  No  4.4 Who has taught you?  CARE  Other.......................

5. Asset Information

5.1 Monthly income: ..............................  5.2 No. of working hours a day ..............................

5.3 No. of working days a month .........................  5.4 Does your household have savings?  Yes  No

5.5 Are these savings: Personal savings / Member of savings group / Credit from NGO / Other ..........................

5.6 Have you taken any loans?  Formal loan  Informal loan  No loans taken

5.7 How many of your family members earn an income? .................  5.8 Do you own your house?  Yes  No

5.9 Do you have access to education?  Yes  No  5.10 Do you have access to health care?  Yes  No

5.11 Are these services satisfactory?  Yes  No  5.12 What are your monthly costs for the following:

<table>
<thead>
<tr>
<th>Rent</th>
<th>Water</th>
<th>Electricity</th>
<th>Cooking fuel</th>
<th>Medical costs</th>
<th>Food</th>
<th>Education</th>
<th>Soap</th>
<th>Latrine maintenance</th>
</tr>
</thead>
</table>

5.13 Do you have membership to:  social group  professional group  political group  other...........

5.14 If yes, give details ................................................................................................................................

6. Perception of non-environmental risk

6.1 What are the main challenges you and your household face today in terms of:

<table>
<thead>
<tr>
<th>Water</th>
<th>Sanitation</th>
</tr>
</thead>
</table>

96
7. Perception of environmental risk

7.1 What are the biggest weather related problems you face today? (adapted from Jabeen et al., 2010)
- Increased heat
- Increased rainfall in shorter time period
- Less rainfall
- Unpredictable rainfall
- Longer flooding periods
- Flash flooding
- Air pollution
- Other

7.2 Are these problems the same or different from when you were young?

7.3 If different, how do you explain this change?

7.4 How often are you flooded? (no. of times a year)

7.5 How long did your last flood last?

7.6 How often do you have heat waves?

7.7 How long did the last heat wave last?

8. Impact of flooding / water-logging

8.1 How does flooding affect you in terms of the following:

<table>
<thead>
<tr>
<th></th>
<th>Answer</th>
<th>How are you addressing this problem?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of water available</td>
<td>Less</td>
<td>More</td>
</tr>
<tr>
<td></td>
<td>More</td>
<td>Same</td>
</tr>
<tr>
<td>Access to water</td>
<td>Less</td>
<td>More</td>
</tr>
<tr>
<td></td>
<td>More</td>
<td>Same</td>
</tr>
<tr>
<td>Distance to get water</td>
<td>Further</td>
<td>Closer</td>
</tr>
<tr>
<td></td>
<td>Closer</td>
<td>Same</td>
</tr>
<tr>
<td>Quality of water</td>
<td>Worse</td>
<td>Better</td>
</tr>
<tr>
<td></td>
<td>Better</td>
<td>Same</td>
</tr>
<tr>
<td>Sources of water used</td>
<td>Same</td>
<td>Different:</td>
</tr>
<tr>
<td>(if different, HOW and WHY)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reliability of water sources</td>
<td>Worse</td>
<td>Better</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------</td>
<td>--------</td>
</tr>
<tr>
<td>If water access &amp; quality is worse, can all household activities using water be undertaken?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Other problems relating to water?</td>
<td>Same</td>
<td>Different:</td>
</tr>
<tr>
<td>Toilet – location (if different, WHERE and WHY)</td>
<td>Same</td>
<td>Different:</td>
</tr>
<tr>
<td>Toilet – infrastructure (if different, HOW and WHY)</td>
<td>Same</td>
<td>Different:</td>
</tr>
<tr>
<td>Toilet – habits (if different, HOW and WHY)</td>
<td>Same</td>
<td>Different:</td>
</tr>
<tr>
<td>Other problems relating to sanitation?</td>
<td>Same</td>
<td>Different:</td>
</tr>
<tr>
<td>Hygiene practice (if different, HOW and WHY)</td>
<td>Same</td>
<td>Different:</td>
</tr>
<tr>
<td>Drainage</td>
<td>Worse</td>
<td>Better</td>
</tr>
<tr>
<td>Sewage</td>
<td>Worse</td>
<td>Better</td>
</tr>
<tr>
<td>Waste management</td>
<td>Worse</td>
<td>Better</td>
</tr>
<tr>
<td>Health (if gets worse or better, WHAT ILLNESS and WHY)</td>
<td>Worse</td>
<td>Better</td>
</tr>
<tr>
<td>Details:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Livelihood / income</td>
<td>Same</td>
<td>Different:</td>
</tr>
<tr>
<td>Access to education (if different, give details)</td>
<td>Same</td>
<td>Different:</td>
</tr>
</tbody>
</table>
8.2 How are your family members affected differently by the problems listed above?

Ask about WATER, SANITATION, HYGIENE, HEALTH, LIVELIHOOD, EDUCATION

<table>
<thead>
<tr>
<th>Men</th>
<th>Answer</th>
<th>How are they addressing this problem?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adolescent girls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elderly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disabled</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. Impact of increase in temperature

9.1 How does the heat affect you in terms of the following:

<table>
<thead>
<tr>
<th>Amount of water available</th>
<th>Less</th>
<th>More</th>
<th>Same</th>
<th>How are you addressing this problem?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to water</td>
<td>Less</td>
<td>More</td>
<td>Same</td>
<td></td>
</tr>
<tr>
<td>Distance to get water</td>
<td>Further</td>
<td>Closer</td>
<td>Same</td>
<td></td>
</tr>
<tr>
<td>Quality of water</td>
<td>Worse</td>
<td>Better</td>
<td>Same</td>
<td></td>
</tr>
<tr>
<td>Sources of water used (if different, HOW and WHY)</td>
<td>Same</td>
<td>Different:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reliability of water sources</td>
<td>Worse</td>
<td>Better</td>
<td>Same</td>
<td></td>
</tr>
<tr>
<td>If water access &amp; quality is worse, can all household activities using water be undertaken?</td>
<td>Yes</td>
<td>No</td>
<td>If no, explain:</td>
<td></td>
</tr>
<tr>
<td>Other problems relating to water?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toilet – location (if different, WHERE and WHY)</td>
<td>Same</td>
<td>Different:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toilet – infrastructure (if different, HOW and WHY)</td>
<td>Same</td>
<td>Different:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toilet – habits (if different, HOW and WHY)</td>
<td>Same</td>
<td>Different:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>------</td>
<td>------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other problems relating to sanitation?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hygiene practice (if different, HOW and WHY)</td>
<td>Same</td>
<td>Different:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drainage</td>
<td>Worse</td>
<td>Better</td>
<td>Same</td>
<td></td>
</tr>
<tr>
<td>Sewage</td>
<td>Worse</td>
<td>Better</td>
<td>Same</td>
<td></td>
</tr>
<tr>
<td>Waste management</td>
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<td></td>
</tr>
<tr>
<td>Livelihood / income</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access to education (if different, give details)</td>
<td>Same</td>
<td>Different:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9.2 How are your family members affected differently by the problems listed above?

Ask about WATER, SANITATION, HYGIENE, HEALTH, LIVELIHOOD, EDUCATION

<table>
<thead>
<tr>
<th></th>
<th>Answer</th>
<th>How are they addressing this problem?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td></td>
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<tr>
<td>Adolescent girls</td>
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<td></td>
</tr>
<tr>
<td>Children</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elderly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disabled</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10. Preparedness (adapted from Soltesova, 2010)

10.1 How do you plan for your water and sanitation needs during the rainy / summer season?
Have your plans changed from the last rainy / summer season? If yes, how?

What would improve your situation for the next rainy / summer season?

Is there anything you are worried about in terms of your water and sanitation in the future?

Support Networks & Local Institutions (adapted from Soltesova, 2010)

Which people / organisations can you ask for help for the problems mentioned? (adapted from Neighbouring households  Landlord  CBO leaders  NGOs  Local Service Providers  Government  Ward Commissioner  Relatives in Dhaka  Relatives outside Dhaka  Other: _____

Who from the list above do you rely on for water and sanitation support?

Who from the list above do you rely on for water and sanitation support during flooding/heat? Why?

What do you need to help you cope better with water and sanitation needs during flooding/heat?

Who would you like to have a better relationship with?
Appendix 6: Types of Drinking Water Sources and Sanitation

The following definitions of drinking water and sanitation facilities are based on those adopted by the WHO/UNICEF Joint Monitoring Programme (JMP) to calculate progress towards MDG target 7c, to halve the proportion of people without sustainable access to basic sanitation and safe drinking water by 2015.


Drinking water categories:

‘Improved’ drinking water sources

- **Piped water into dwelling**: also called a household connection, is defined as a water service pipe connected with in-house plumbing to one or more taps (e.g. in the kitchen and bathroom).

- **Piped water to yard/plot**: also called a yard connection, is defined as a piped water connection to a tap placed in the yard or plot outside the house.

- **Public tap or standpipe**: is a public water point from which people can collect water. A standpipe is also known as a public fountain or public tap. Public standpipes can have one or more taps and are typically made of brickwork, masonry or concrete.

- **Tubewell or borehole**: is a deep hole that has been driven, bored or drilled, with the purpose of reaching groundwater supplies. Boreholes/tubewells are constructed with casing, or pipes, which prevent the small diameter hole from caving in and protects the water source from infiltration by run-off water. Water is delivered from a tubewell or borehole through a pump, which may be powered by human, animal, wind, electric, diesel or solar means. Boreholes/tubewells are usually protected by a platform around the well, which leads spilled water away from the borehole and prevents infiltration of run-off water at the well head.

- **Protected dug well**: is a dug well that is protected from runoff water by a well lining or
casing that is raised above ground level and a platform that diverts spilled water away from the well. A protected dug well is also covered, so that bird droppings and animals cannot fall into the well.

- **Protected spring**: The spring is typically protected from runoff, bird droppings and animals by a "spring box", which is constructed of brick, masonry, or concrete and is built around the spring so that water flows directly out of the box into a pipe or cistern, without being exposed to outside pollution.

- **Rainwater**: refers to rain that is collected or harvested from surfaces (by roof or ground catchment) and stored in a container, tank or cistern until used.

‘Unimproved’ drinking water sources

- **Unprotected spring**: This is a spring that is subject to runoff, bird droppings, or the entry of animals. Unprotected springs typically do not have a "spring box."

- **Unprotected dug well**: This is a dug well for which one of the following conditions is true: 1) the well is not protected from runoff water; or 2) the well is not protected from bird droppings and animals. If at least one of these conditions is true, the well is unprotected.

- **Cart with small tank/drum**: This refers to water sold by a provider who transports water into a community. The types of transportation used include donkey carts, motorized vehicles and other means.

- **Tanker-truck**: The water is trucked into a community and sold from the water truck.

- **Surface water**: is water located above ground and includes rivers, dams, lakes, ponds, streams, canals, and irrigation channels.

- **Bottled water**: is considered to be improved only when the household uses drinking-water from an improved source for cooking and personal hygiene; where this information is not available, bottled water is classified on a case-by-case basis.
Sanitation categories:

‘Improved’ sanitation

- **Flush toilet**: uses a cistern or holding tank for flushing water, and a water seal (which is a U-shaped pipe below the seat or squatting pan) that prevents the passage of flies and odours. A pour flush toilet uses a water seal, but unlike a flush toilet, a pour flush toilet uses water poured by hand for flushing (no cistern is used).

- **Piped sewer system**: is a system of sewer pipes, also called sewerage, that is designed to collect human excreta (faeces and urine) and wastewater and remove them from the household environment. Sewerage systems consist of facilities for collection, pumping, treating and disposing of human excreta and wastewater.

- **Septic tank**: is an excreta collection device consisting of a water-tight settling tank, which is normally located underground, away from the house or toilet. The treated effluent of a septic tank usually seeps into the ground through a leaching pit. It can also be discharged into a sewerage system.

- **Flush/pour flush to pit latrine**: refers to a system that flushes excreta to a hole in the ground or leaching pit (protected, covered).

- **Ventilated improved pit latrine (VIP)**: is a dry pit latrine ventilated by a pipe that extends above the latrine roof. The open end of the vent pipe is covered with gauze mesh or fly-proof netting and the inside of the superstructure is kept dark.

- **Pit latrine with slab**: is a dry pit latrine that uses a hole in the ground to collect the excreta and a squatting slab or platform that is firmly supported on all sides, easy to clean and raised above the surrounding ground level to prevent surface water from entering the pit. The platform has a squatting hole, or is fitted with a seat.

- **Composting toilet**: is a dry toilet into which carbon-rich material (vegetable wastes, straw, grass, sawdust, ash) are added to the excreta and special conditions maintained to produce inoffensive compost. A composting latrine may or may not have a urine separation device.
• **Special case:** A response of “flush/pour flush to unknown place/not sure/DK where” is taken to indicate that the household sanitation facility is improved, as respondents might not know if their toilet is connected to a sewer or septic tank.

‘Unimproved’ sanitation

• **Flush/pour flush to elsewhere:** refers to excreta being deposited in or nearby the household environment (not into a pit, septic tank, or sewer). Excreta may be flushed to the street, yard/plot, open sewer, a ditch, a drainage way or other location.

• **Pit latrine without slab:** uses a hole in the ground for excreta collection and does not have a squatting slab, platform or seat. An open pit is a rudimentary hole.

• **Bucket:** refers to the use of a bucket or other container for the retention of faeces (and sometimes urine and anal cleaning material), which are periodically removed for treatment, disposal, or use as fertilizer.

• **Hanging toilet or hanging latrine:** is a toilet built over the sea, a river, or other body of water, into which excreta drops directly.

• **No facilities or bush or field:** includes defecation in the bush or field or ditch; excreta deposited on the ground and covered with a layer of earth (cat method); excreta wrapped and thrown into garbage; and defecation into surface water (drainage channel, beach, river, stream or sea).
Appendix 7: Water and Sanitation Rights in Theory

The right to water means: (i) having access to 50 to 100 litres of water per person per day to ensure basic needs are met; (ii) the water source is within 1000 metres from home; (iii) water cost should not exceed more than 3% of household income, and (iv) collection time should not exceed 30 minutes (UN-Water, 2010a).

The right to sanitation means: (i) access to, and use of, excreta and wastewater facilities and services that ensures privacy and dignity, and (ii) ensures a clean and healthy living environment (SDC, 2010). 'Facilities and services' refers to the collection, transport, treatment and disposal of human excreta, domestic wastewater and solid waste, and associated hygiene promotion (ibid).
Appendix 8: WSUP Recommendations for DWASA (Dhaka’s Water & Sewerage Authority)

To build the capacity of DWASA in facilitating pro-poor service delivery, WSUP recommend the following (CBSG, 2010: 8):

1. **DWASA to assert its policy of an equitable approach to water service provision for all inhabitants within DWASA’s service area.** For all inhabitants to be recognised as having a right to water service connection with the same level of service and ensuring a single tier service with clear processes for requesting connections for consumers irrespective of economic status.

2. **Introduce a Low Income & Slum Community Services Support Cell at Head Office.** The proposed cell to provide support to Zonal/MODS managers in proactively supporting the delivery of services to low income and slum communities providing connections and in planning and developing specific programs for low-income community expansion. The cell will facilitate common policy and processes across DWASA and support MODS zones in the delivery process.

Specific tasks of the cell will include to determine DWASA policy and process vis a vis slum service delivery (e.g. for application processes, bulk supply contract mechanisms, connection times, etc.); coordinate and monitor implementation across the whole of DWASA service area; set zonal targets for connecting low income areas; monitor zone operational performance against connection targets; act as a focal point for funding and implementation agencies interested in supporting urban poor service delivery; determine communication and awareness messages to encourage connection; set policy for eradication of illegal connections within DWASA network; regulation of small scale service providers; etc. Their support will also include appropriate advocacy at the policy level to ensure regular budget for service delivery for the slum population. They will develop a targeted advocacy strategy focusing on donors, international development partners, DWASA board and policy level officials at the ministry. Specific measures also need to be taken at the informal settlement level to create awareness on the rights as well as responsibilities of the slum dwellers with regard to WSS services. A special communication and advocacy strategy should be developed by the cell for the low-income communities.

The cell should be properly integrated and engaged with the Zonal/MODS organisation, the mainstream service delivery organ of DWASA. Therefore, we propose that the cell is operationally linked to the Zonal/Mods organisation by means of a direct reporting line to the Chief Engineer.
cell will be headed by an Executive Engineer and include staff with planning, communications, engineering, finance, and operational experience.

It is also suggested that for the first two years of operation the cell is overseen by a steering committee chaired by the Managing Director and comprised of key staff from the head office and Zonal/MODS.

3. **Empower the Zonal/MODS Managers to support connection provision to low-income communities through proven mechanisms.** The Zonal/MODS organisation is the interface for service delivery for all customers irrespective of economic status. Full authority and responsibility should be given to the Zonal/Mods Managers to accept applications from and provide connections to low income and slum communities in line with the appropriate DWASA policy.

4. To support the anticipated increase in connection activity at the Zonal/MODS level it is suggested that DWASA re-assign three staff in each MODS (one Sub-Assistant Engineer and two Community Organisers) to support its current structure to ensure WSS services to informal settlements. These three will form a small “Community Wing” within the MODS zone and will work under the direct supervision of the concerned MODS Executive Engineer. These positions may be created from the approved zonal level human resources by redesigning their job description and work responsibilities.

**Incentivise the Performance of the Zonal/MODS Organisations:** Increasing water provision to the low income and slum communities has benefits for customers and DWASA alike. For DWASA the benefits are increased revenues and reduction in NRW levels through the conversion of illegal to legal connections.

Zonal/MODS Managers can be incentivised through performance indicators such as number of connections made; revenue collected from low income and slum community connections; The incentive programs could be structured such that the cost of the incentives is met from additional revenues generated through the new connections.

6. **Promote initiatives for private participation in the distribution of water in low income and slums communities.** It is well established that slum dwellers in Dhaka pay much more than other residential counterparts for water supply through private vendors. Specific regulatory measures need to be in place to safeguard slum dwellers from any monopolistic water-pricing tendency by the
private sector. DWASA should clarify the policy environment vis a vis connection provision to low income and slum communities and the support they will provide to the development and formalisation of small scale independent providers in low income and slum areas and how they will regulate the quality of service (particularly water quality) and pricing.

7. **Undertake Appropriate Capacity Building:** A comprehensive and targeted capacity building will be necessary to make the proposed cell functional and effective. The elements of the capacity building will include: Organizing appropriate logistics, providing orientation to central as well as Zonal committees; training to the professional staff of the proposed circle based on a needs assessment.

8. **Undertake a tariff study** to review alternative tariff structures including progressive tariff and different tariffs for different groups of consumers in different consumer areas. This will help rationalize water use and saving from the high end users will allow DWASA to bring water to low supply areas. The tariff rate for the bulk connections in slums should also be considered in the study in terms of the socio-economic condition of the slum people and the commercial interest of DWASA.

9. **Instigate an action learning program** to understand urban sanitation and hygiene behaviour, in particular to determine what motivates people to follow proper sanitation practices and rational use of water resources. Based on the learning, appropriate action plans should be prepared for sanitation and hygiene promotion in Dhaka.
Appendix 9: Focus Group Discussion Participants

1. Men FGD
Kalshi Balurmath (8 August 2011)
Md Habib
Md Aslam
Md Dilu
Sekh Solaiman
Ukiluddin
Md Salim Munshi
Matiur Rahman
Md Joinal
Md Monir
Md Altaf
Md Mintu
Abdul Aziz

2. Women FGD
Kalshi Balurmath (10 August 2011)
Maksuda
Rahima
Parvin
Bely
Sumi
Hajera
Shahjadi
Nasima
Kohinur
Nargis
Peyara

3. Adolescent Girl FGD
Kalshi Balurmath (11 August 2011)
Rubina
Tania (1)
Sanu
Sarmin
Tania (2)
Sonia
Kajoli
Asma (1)
Munni
Rumana
Khadija
Nasima
Min
Bithi
Asma (2)
Tanzila
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