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Review of relevant policies/strategies, plans and programmes relating to health and climate change in Bangladesh

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Executive Summary

This report provides relevant background material for output 2 of the larger WHO project which has a stated outcome of 'Improved global health adaptation policy and practice supported by robust evidence from field testing in 4 countries, with reduce vulnerability in poor populations'. Specifically Output 2 has the stated goal of '*Climate resilient & health-promoting water and sanitation policies defined and implemented at a national level in four countries'.*

To complete this task, two key activities were completed:

i) A review of the current global and national guidance on climate change vulnerability assessment and adaptation with a particular focus on health and in particular, water issues; and

ii) Description of the current policy settings and processes in Bangladesh in order to implement climate resilient and health promoting water and sanitation policy.

The data used for this report was largely drawn from available government policy and strategy documents, NGO and government reports and peer-reviewed literature, and to a lesser extent, inputs from relevant stakeholders in Bangladesh. It aims to provide a starting point for discussion with a diverse range of stakeholders in Bangladesh in order to prepare a much more comprehensive document. Though Output 2 is focussed on climate change resilience and water and sanitation issues, this report has considered a range of climate sensitive diseases to provide context, and in its analysis has examined policy settings for the health sector more broadly, acknowledging the many linkages between water and sanitation and other health impacts of climate change.

The health response to climate change at a global level was examined through identification of national health assessments and adaptation and the research field. At a country level, very few developed countries have conducted comprehensive climate change vulnerability assessments or developed comprehensive related adaptation plans, and even fewer have developed specifically health focused climate change adaptation plans, instead acknowledging the many determinants of health impacts relating to climate change and preferring to integrate health within other thematic areas. The NAPA process has encouraged national level adaptation plans in many developing countries, but health considerations are scarce and plans are lacking focussed health attention.

Climate change and health research is a relatively new field, with a major increase in research activity in the past 6-7 years. However, until recently, much of the research was focussed on quantifying the impacts of climate change with an emphasis on the easily measurable, more direct health outcomes with limited research focus on the less direct effects or on climate change and health adaptation issues. This gap has been identified by the recent WHO research needs publication (WHO, 2009), which identified a series of research gaps that need to be addressed to better inform adaptation development and practice. Any country developing a research strategy for climate change and health should draw on the guidance provided by this document.

There are a number of key global guidance documents that provide important resources for policy and decision-makers designing and implementing climate change adaptation strategy (WHO, 2013;

UNEP-UNDP, 2011; EU 2013a,b). The key issues identified that span many of the guidance documents include:

- linking scientific evidence and policy and practice
- framing adaptation – a social/vulnerability and/or physical/hazards approach
- mainstreaming adaptation
- linking adaptation to development
- an iterative and evolving approach
- community based adaptation

Mainstreaming adaptation is a recurrent theme of guidance documents. The examples provided on mainstreaming climate change and health considerations into policy documents in the EU context provide a useful starting point (EU 2013a,b).

Common to all guidance is the need for monitoring and evaluation of implementation. A clear implementation framework that clearly articulates roles and responsibilities of agencies for adaptation tasks with timeframes, clear monitoring, evaluation and reporting requirements will be critical to successful adaptation. Emerging tools to assess vulnerability reduction at the project level (eg. WHO's Vulnerability Reduction Assessment tool) are being developed and will be necessary to complement national level monitoring and evaluation processes.

Although some useful information is provided by national health assessments, specific research on a diversity of climate change and health topics and much NGO activity in diverse areas related to reducing climate change vulnerability such as poverty alleviation, disaster risk reduction, and WASH projects, there is a lack of a clear and comprehensive national research agenda on climate change and health impacts and adaptation.

The establishment of the high level NAPA policy (2005) and associated action plan (BCCSAP, 2009) and the explicit consideration of climate change into parts of the influential National Poverty Reduction Strategy, provide a strong platform for Bangladesh's climate change adaptation efforts. Despite some important progress by key sectors in recognising the potential climate change and health issues (e.g. HPNSDP, National Water Management Plan, Disaster Management policy) key issues and opportunities identified include:

- Inadequate comprehensive recognition of climate change adaptation and integration of issues and actions across key climate sensitive portfolios
- Limited vertical integration and coordination
- Need for clear and authoritative leadership
- Ineffective strategy implementation
- Identifying mainstreaming opportunities

In order to improve health adaptation action in Bangladesh, analysis and discussion is required around the key issues of:

- ***Defining the climate change health sector*** – so that the scope of health interests can be defined and so that other agencies know where to seek advice and information

- ***Addressing gaps in knowledge*** – a national strategic mechanism to address the gaps in knowledge is necessary, and should ensure that research outputs will inform adaptation policy and practice
- ***Prioritizing health issues for focus*** – an approach to prioritizing the health issues for adaptation needs to be identified. Such an approach should not only rely on quantitative vulnerability assessments often constrained by data quality and availability, but recognise that qualitative methods of assessment can provide a useful starting point within reasonable timeframes.
- ***Who 'health' should engage with?*** – the health sector needs to develop a clear strategy for engagement in climate change and health adaptation that includes an analysis of within health engagement (health infrastructure, patient service provision, preventive health policy) and other agencies (within government and external to government)
- ***In what capacity should the health sector engage?*** – the health sector needs to clearly identify its role in climate change and health adaptation action and consider what training and capacity building is required to ensure effective engagement.
- ***Where health should engage?*** – where in space and time and at what institutional level?

Specific recommendations for the health sector include:

- Identify a central point/agency/organisation to represent the span of health interests relating to climate change that considers the breadth of health issues provided by WHO (2009) and incorporates the social issues identified by WHO et al (2013).
- Engage in four distinct action areas:
    - Research – health vulnerability and impacts and effectiveness of adaptation responses
    - Awareness raising and capacity building with community and other sectors about health and climate change
    - Integration of climate change into health policies within the health sector and system
    - Integration of health into climate change related adaptation and mitigation policies
- Build on the existing evidence base of health impacts of climate change, existing adaptation options and their impacts through a mechanism such as the development of a national research agenda and considering the types of research areas identified by WHO (2009).
- Draw on principles and examples provided by global guidance (e.g WHO, UNDP, EU) to identify vulnerable regions or 'hotspots', prioritize health risks for action and then develop a series of appropriate short, medium and long term actions within an implementation framework.
- Where possible, modify existing health infrastructure and basic service infrastructure to make it more resilient to projected climate changes, and develop systems and approaches to include climate resilience into future infrastructure and system design
- Develop a framework for monitoring, evaluation and review that acknowledges the rapidly changing knowledge base relating to impacts and adaptation effectiveness and the iterative nature of adaptation.
- Support and resource local government to engage in, and where necessary lead, climate change adaptation projects related to health.
- Build the capacity of health professional staff to advocate, lead, coordinate, plan or implement climate change and health adaptation activity.

Specific recommendations for the WASH sector include:

- Improve engagement with the broader water management sector to ensure that water for protection of human health is a priority water use now and in the future.
- Consider engaging with the water management sector regional management plan process to identify and prioritize those regions with significant water management issues, now and into the future.
- Encourage routine assessment of vulnerability reduction by WASH projects through utilisation of the WHO Vulnerability Reduction Assessment tool or other similar tools.
- Coordinate and synthesise the learnings from the many WASH projects (NGO and government led) implemented in the community to identify effectiveness of adaptation actions with a view to providing more evidence-based guidance.
- Develop mechanisms for assessment of maladaption – how can Health/WASH routinely engage with processes of other agencies to check for unintended health impacts of climate change adaptation activities in other sectors (e.g. industry, agriculture).
- Share the learnings from some of the existing government activities (e.g. Including WSP considerations into Vetting Guidelines) in order to promote opportunities for mainstreaming climate change adaptation actions into other health related areas (eg. vector borne disease, heat waves)
- Utilize the work of WHO/DFID (2013) to conduct an assessment of climate change resilience of WASH projects in high risk regions or 'hot-spot' areas
- Utilize the work of WHO/DFID (2013) to design criteria for assessing climate change resilience of WASH projects in the Bangladesh context across the two time dimensions: for existing programs and infrastructure and for future programs and infrastructure.

These recommendations for the health/ WASH sectors will contribute to improvements in climate change and health adaptation practice and support the establishment of a more formal process of adaptation plan development and implementation. However, in order to develop a climate change and health adaptation plan for Bangladesh, the stepwise process recommended by WHO (2010) should be adopted with urgent priority given to the critical first step on framing and scoping the assessment. This will need to involve the key stakeholders as a starting point in order to define the task, decide on the scope and approach of the assessment, the policy context, the project team and project plan, establish a stakeholder process and develop a communications plan. The development of a specific health adaptation plan will need to occur within the broader climate change adaptation work undertaken under the leadership of the MoEF so as to avoid duplications and complement broader efforts.

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LIST OF ABBREVIATIONS USED

ADB: Asian Development Bank
APF: Adaptation policy framework
BCAS: Bangladesh Centre for Advancement Studies
BCCSAP: Bangladesh Climate Change Strategy and Action Plan
BCCTF: Bangladesh climate change trust
BIDS: Bangladesh Institute of Development studies
BMD: Bangladesh Meteorological Department
BRAC: Bangladesh Rural Advance Committee
CCA: Climate Change adaptation
CCC: Climate Change Cell
CDMP: Comprehensive Disaster Management Program
CEGIS: Centre for Environmental and Geographic Information Services
CMIP5: Coupled Model Intercomparison Project phase 5
COP: Conference of Parties
DALY: Daily Adjusted Life years
DFID: Department of International Development
DoE: Department of Environment
DOTS: Direct Observed Treatment Short-Course
EPR: Emergency preparedness and Response
EU: European Union
GCM: Global circulation models
GoB: Government of Bangladesh
HFA: Hyogo Framework for Action (HFA)
HIA: Health impact assessment
HPNSDP: Health, Population and Nutrition Sector Development Program
HVAM: Health Vulnerability Assessment Methodology
IPCC: Intergovernmental panel on climate change
ITN: Insecticides treated net
LLIN: Long lasting impregnated nets
MDG: Millennium Development Goals
MoEF Ministry of Environment and Forest
MOH&FW: Ministry of Health and Family Welfare
MSL: Mean sea level
NAPA: Bangladesh National Adaptation Programme of Action
NaMIS: National Management Information System
NGO Non-Government Organization
NID National immunizations day
NPDM: National Plan for Disaster Management
PHC Primary Health Care
PID Parasitic and infectious diseases

PPPDU: Policy, Program and Partnership Development Unit RCM: Regional climate models
PRSP: Poverty Reduction Strategy Paper (PRSP),
SEAR: South East Asia Region
SFA: SAARC Framework for Action
SPARRSO Space Research and Remote Sensing Organization
SWAp: Sector Wide Approach
UCL: The University College London
UHFWC Union Health and Family Welfare Centre
UKCIP: UK climate impacts program
UNDP: United Nations Development Program
UNDAF: United Nations Development Assistance Framework
UNEP: United Nations Environment Program
UNFCCC: United Nations Framework Convention on Climate Change
VA: Vulnerability assessment
VAM: Vulnerability assessment methodologies
WASH: Water Sanitation and Hygiene
WB: World Bank
WCDR: World Conference on Disaster Reduction
WHO: World Health Organization
WMO: World Meteorological Organization
WSF: Water Safety Framework
WSP: Water safety Plan

INTRODUCTION

Climate change presents significant global health challenges (Costello et al, 2009), particularly in developing regions of the world where populations are particularly vulnerable for many reasons. Climate change has a major impact on the hydrological cycle and water related impacts make a significant contribution to existing and projected health impacts. Climate change threatens to undermine many of the gains made in developing regions with regards to water, sanitation and hygiene MDGs. However in many parts of the world, health and climate change adaptation response has been limited despite national efforts by many countries to develop climate change adaptation plans.

WHO Bangladesh is implementing a large project on 'Building Adaptation to Climate Change in Health in Least Developed Countries through Resilient WASH' with the support of DFID. The overall project consists of 4 identified outputs that need to be addressed to improve global health adaptation policy and practice supported by robust evidence from field testing in 4 countries.

This report focuses on providing relevant material for output 2 '*Climate resilient & health-promoting water and sanitation policies defined and implemented at a national level'.* The scope for this output is to define the necessary policy settings and processes in Bangladesh in order to implement climate resilient and health promoting water and sanitation policy. To complete this task, two key activities were completed:

i) A review of the current global and national guidance on climate change vulnerability assessment and adaptation with a particular focus on health and in particular, water issues; and

ii) a description of the current policy settings and processes in Bangladesh in order to implement climate resilient and health promoting water and sanitation policy.

The data used for this report was largely drawn from available government policy and strategy documents, NGO and government reports and peer-reviewed literature, and to a lesser extent, inputs from relevant stakeholders in Bangladesh. It aims to provide a starting point for discussion with a diverse range of stakeholders in Bangladesh in order to prepare a much more comprehensive document. Though Output 2 is focussed on climate change resilience and WASH issues, this report has considered a range of climate sensitive diseases to provide context, and in its analysis has examined policy settings for the 'health' sector more broadly, acknowledging the many linkages between WASH and other health impacts of climate change.

The report consists of 4 sections. **Section 1** provides an overview of climate change health impacts and responses from a general perspective, describing the key environmental pathways through which health is affected and identifying the importance of social dimensions. It is not a comprehensive or systematic review of the literature, but rather provides a picture of the general relationships between climate change and health for the more common climate sensitive health issues. This section also includes a subsection on current health responses to the existing climate change health impacts, including examples of national health and climate change assessments.

Section 2 focuses on 'Vulnerability assessment and adaptation to climate change – global guidance and practice'. It provides an overview of the approaches and methods that are being taken globally to assess vulnerability to climate change and develop adaptation strategy in response. It includes water and health specific guidance and issues but also considers broader guidance particularly for adaptation as there are a range of cross-cutting issues, common to all sectors designing and developing adaptation responses. This section also looks at the application of these approaches and describes some of the health assessments and adaptation plans produced in differing contexts around the world to provide examples of the diversity of approaches used.

Section 3 explores health impacts of climate change and climate change policy and strategy in Bangladesh. It summarises existing studies on health impacts in Bangladesh, analyses the existing institutional and policy environment, and identifies the consideration given to climate change and health and the relationships between policy, strategy and implementation and monitoring. It also describes the important role of NGOs to respond to climate change impacts and influence health outcomes through programs and projects.

Finally, **Section 4** examines opportunities for the health sector in response to climate change in Bangladesh. It draws on the global material provided in Sections 1 and 2 and the Bangladesh context described in Section 3. The analysis concludes with recommendations for development of a more consolidated and evidence based climate change and health response that will be necessary to address the priority health issues that climate change is amplifying now, and will continue to do so in the future.

While the focus of this report is on providing the recommendations for developing adaptation strategies for climate-sensitive diseases such as those related to water quality and sanitation and vector-borne diseases, much can also be learnt about methodology and issues relating to vulnerability assessment and climate change adaptation from the general literature as many of these issues are cross-cutting.

BACKGROUND

Despite early recognition by WHO of the important relationships between climate change and health (WHO, 2003), the Lancet Commission's work published in 2009 (Costello et al, 2009) highlighted the significance of the breadth of health impacts of climate, providing an impetus for not only a better understanding of the quantitative relationships between climate change and climate sensitive diseases in the future, but also a better understanding of the existing relationships between climate variability and climate sensitive diseases and broader health issues. In addition, new areas of research have started to identify and conceptualise the less direct health effects of climate change, for example those relating to migration (eg. McMichael et al, 2013).

Coinciding with the increased interest in the health consequences of climate change has been the increased recognition of climate change adaptation, as reflected in the focus of the 2007 IPCC report (IPCC, 2007). This has led to a greater balance in the research and policy focus on both mitigation and climate change adaptation. Compared with the climate change mitigation agenda, where health has a limited, though important advocacy role, the health sector, has a legitimate 'place at the table' in the adaptation context, as there are concrete actions that must be taken for communities and countries to effectively adapt to the expected changes in health impacts resulting from climate change, and because adaptation actions taken by others may enhance health benefits, but also further increase adverse health impacts.

However, like many other public health issues, understanding climate change and health impacts and responses is challenged by complexity and interactions in, and between, causal pathways, multiple determinants, differing timeframes of impact, diversity in spatial impacts due to underlying vulnerability and uncertainty associated with future climate changes. In addition climate change affects health through many pathways, many of which are not the sole responsibility of the health sector. Collectively these factors mean that understanding climate change health impacts and developing appropriate adaptation strategy requires considerable local analysis and collaboration between key stakeholders.

Water is the primary medium through which climate change poses a major threat to humans and the environment (UNWATER, 2009). Some countries, like Bangladesh, have a particular high vulnerability to water related impacts due to their large river systems, existing rainfall systems, large and highly populated coastal environments and exposure to seasonal flooding and cyclone activity. Suitable water quality and adequate sanitation and hygiene are essential for human health and wellbeing and a significant development focus in many countries in recent years has been on achieving the MDGs relating to water, sanitation and hygiene (WASH). Hence, consideration of the impacts of climate change on meeting WASH goals and developing adaptation strategies to reduce the negative impacts of climate change should be a high priority for many developing countries.

Bangladesh has made progress in climate change adaptation through the development of its NAPA (2005) and strategy and action plan (BCCSAP, 2009). Despite identification of actions in the BCCSAP that relate to health and mention of climate change and health issues in sectoral policies and plans, a national focus on health adaptation has been limited.

SECTION 1 CLIMATE CHANGE AND HEALTH IMPACTS

1.1 Climate change and health impacts

It is generally agreed that climate change is not creating any new or unknown health threats, but it will increase particular interactions between environments and humans, animals and plants. The ways in which the environmental alterations associated with climate changes impact on human health are identified in Figure 1.1.

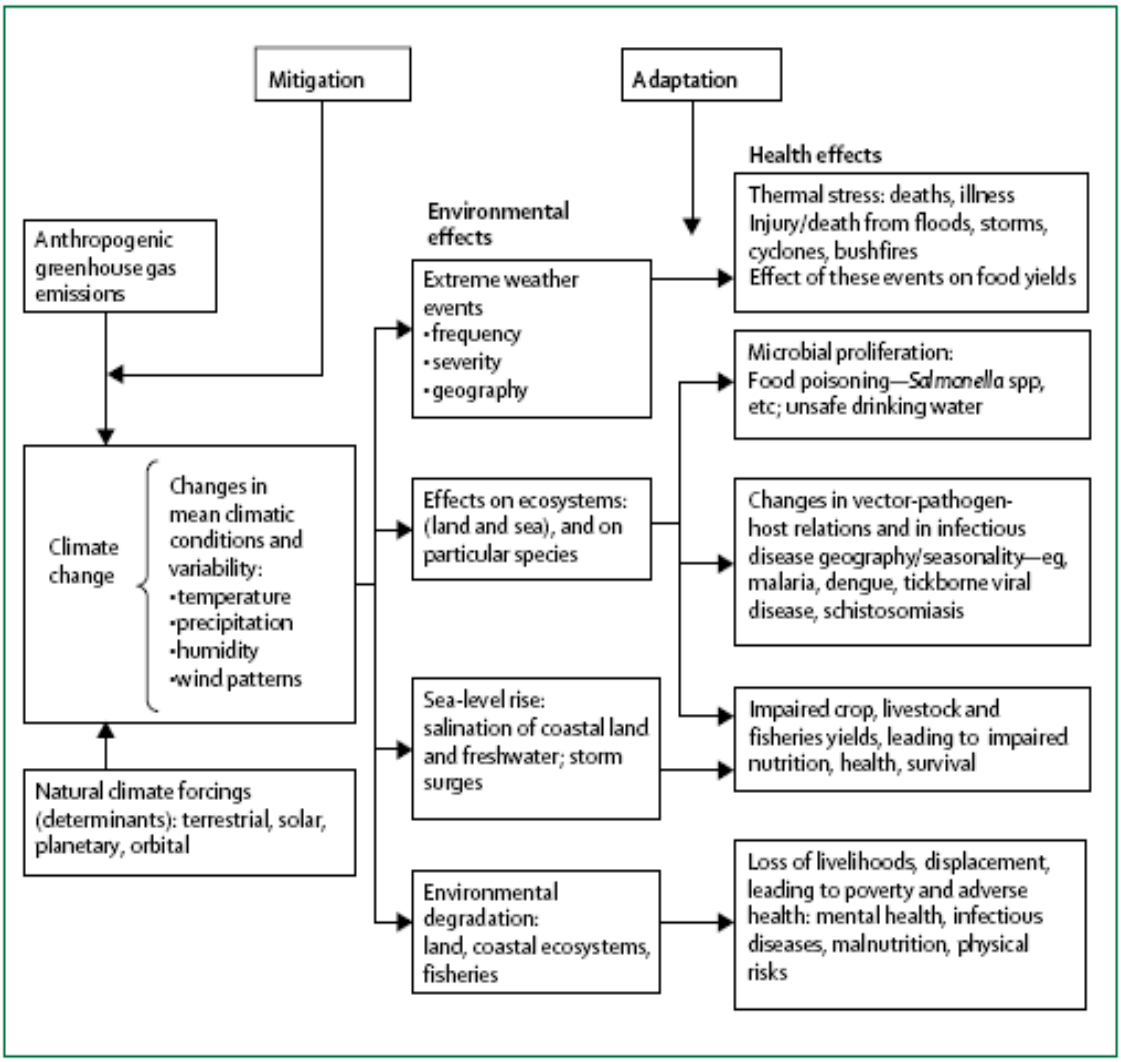

Figure 1.1 – Impacts on human health from alterations of the environment related to climate changes (Source: McMichael et al 2006).

WHO (2011) provides a useful categorisation of the impacts of climate change on human health. The three categories include:

- **The impacts of climate change on natural and physical systems that impact on health of populations**.

These natural and physical systems are identified in Figure 1.1 as land and sea ecosystems, coastal environments, freshwater systems and fisheries and particular species. This category encompasses the water and vector-borne health impacts commonly categorised as climate sensitive diseases.

- **The impact of climate change on alterations to extreme weather events** (eg. cyclones, flooding, drought, heatwaves).

Extreme weather events already contribute to significant global mortality and morbidity, with much larger impacts in developing countries where existing infrastructure is less resilient and disaster responses are constrained by resources and capacity. The types of impacts following extreme events are diverse and range from acute mortality and injury from drowning, collapsed buildings, flying debris, water and vector-borne illnesses to longer term mental health impacts related to personal loss and displacement. In many parts of the world, projected climate changes are associated with increased numbers of extreme events and/or increased severity of events. Some geographical regions are predicted to be exposed to extreme weather events not previously exposed to, while others, like Bangladesh, are likely to experience more intense events.

- **Climate change impacts through economic dislocation, environmental decline and development setbacks associated with infrastructure damage and livelihood loss associated with climate changes.**

Climate change impacts of declining water quality, land availability, regular infrastructure damage, water supply and quality, restrictions to food supply and livelihood loss in some parts of some countries of the world is argued to become an additional future driver of rural to urban migration (McMichael et al., 2012). Though migration to urban areas can provide new livelihood opportunities, it exposes migrants to new risks associated with overcrowding and inadequate access to water, drainage, and sanitation facilities and increased transmission of vector- and water-borne diseases (World Bank, 2013). In addition, the poorest urban dwellers tend to be located in vulnerable areas, such as floodplains and steep slopes, further placing them at risk of extreme weather events and their lack of land tenement restricts their adaptation choices (Jabeen and Johnson, 2013).

Of course, the health impacts of climate change are not only related to physical changes. Social conditions and the community and health system capacity to respond and adapt are also crucial to determining the extent and the severity of health impacts. These additional pre-conditions for health impacts are visually indicated by Figure 1.2. This conceptual framework more accurately represents the concept of vulnerability to climate change from a health perspective.

The social conditions to a large degree explain the differential impacts of climate change on health in the developed and developing world. As bluntly pointed out by Smith (2008), "*The rich will find their world to be more expensive, inconvenient, uncomfortable, disrupted and colourless; in general, more unpleasant and unpredictable, perhaps greatly so. The poor will die.*"

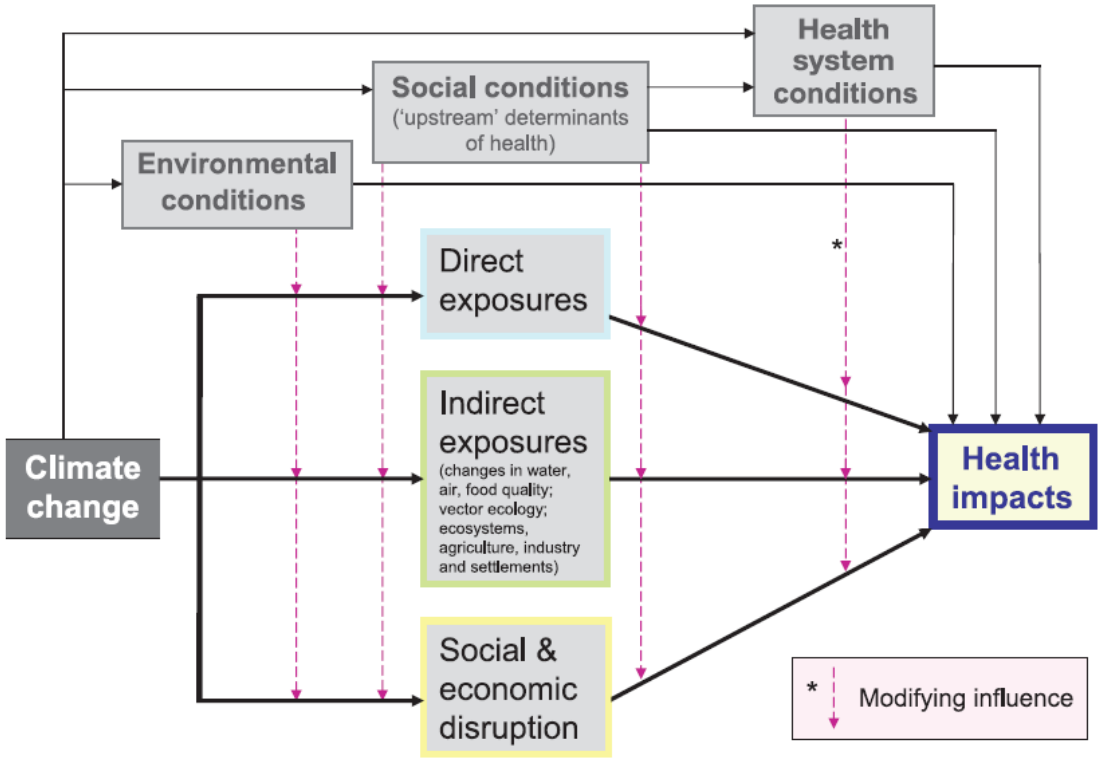

Figure 1.2 Climate change impacts on health modified by environmental, social and health system conditions (Source: Confalonieri, 2007).

Social conditions in the context of climate change adaptation are the subject of a recent multi-global agency discussion paper (WHO et al, 2013) that clearly identifies that health vulnerability of communities is highly influenced by not only exposure to climatic changes, but social issues that impact on both sensitivity and adaptive capacity.

In this report climate sensitive diseases will be the focus and these are defined here under 4 key sections: water-borne diseases, vector-borne disease, impacts of extreme events relating to natural disasters and heat related health impacts. Other important Issues such as food security and food safety, health impacts relating to population displacement and urbanisation and health conditions such as mental health are not included, though some of the principles and concepts for climate change adaptation equally apply to the breadth of health impacts, both direct and indirect.

1.1.1Climate change and water related health issues

Improving access to safe drinking water and basic sanitation, and encouraging hygiene (WASH) have the potential to improve the quality of life of billions of individuals, especially of the poor. Globally, improving water, sanitation and hygiene has the potential to prevent at least 8.4% of the disease burden (WHO, 2013) measured as disability-adjusted life years or DALYs. Of the total DALYs, developing countries share the greatest burden (almost 99%) (Pruss, 2008). The global importance of water, sanitation and hygiene for improving health is reflected in the United Nations Millennium Development Goals (MDGs), explicitly, Goal 7, Target c, which aims to reduce by half the proportion of people without sustainable access to safe drinking water and basic sanitation by 2015.

Furthermore water management, safe water supply and sanitation, and hygiene are also critical for the achievement of the MDGs related to poverty, education, gender equity, reducing child mortality, improving maternal health and reducing the burden of malaria (WWAP, 2012, Hunter, 2010). However, until now an estimated 768 million people do not use drinking water from an improved water source with large disparity between urban and rural areas (JMP, 2013).

Water is essential for all aspects of life. Inadequacies in water supply not only have adverse health consequences but also prevent good sanitation and hygiene (Hunter, 2010). Any change in the quantity or quality of water resulting from pathogens, toxins and chemical contamination lead to water-related health problems such as diarrhoea, typhoid, hepatitis or arsenicosis. Additional health risks could be associated with using water from unsafe sources following unpleasant tastes or odours of water considered to be pathogen free (such as, arising from iron content of groundwater, water salinity, or linked with chlorination) or effects on physical health, especially to women and children, for fetching safe water and carrying heavy containers from a long distance (Hunter, 2010). Moreover high influence of water on human livelihoods and economies of the world can also affect health indirectly.

Only 1% of the world's total freshwater is available for human use, of which the major part is utilized for agriculture and industrial processes. Furthermore increasing population, largely in urban areas, changing lifestyle and consumption patterns and growing economic activities are creating pressures on freshwater resources through increased water demands and pollution (WWAP, 2012). With increasing demand and climate variability the problem of water scarcity can extend. The risk is particularly higher in developing countries due to geographical location and dependency on climate-sensitive economies (World Bank, 2013).

Water is the primary medium through which climate change poses major threat to humans and the environment (UNWATER, 2009). The effects of climate change on the components of the hydrological system include changing precipitation patterns; increasing evapotranspiration; snow cover and melting of ice and glaciers; changes in soil moisture and water content; and variable surface runoff (Green, 2011, IPCC, 2007). The impacts of climate change on freshwater resources in turn will contribute to wide-ranging social and environmental consequences (Batchelor, 2011). However, the prediction of climate change impacts on water resources is uncertain and complex. In Sub Saharan Africa and South Asia the lack of data and Global Circulation Models cannot accurately replicate past and present climatic conditions, therefore prediction of future scenarios remain less confident, especially for rainfall, runoff and recharge (Calow, 2011). Despite this complexity certain future trends for water resources are predicted with higher confidence. Variability of annual average rainfall is forecast across the regions with increasing frequency and intensity of droughts and floods (Batchelor, 2011). Climate-induced sea level rise and changing groundwater recharge will accelerate saltwater intrusion in coastal aquifers leading to a reduction of quality and amount of freshwater resources available in coastal aquifers (Ranjan, 2009). Due to glacier melting apparent high flow in glacier-fed rivers will follow a considerable reduction of river flow and freshwater availability with progressive disappearance of glaciers. For example in South Asia glaciers and snowmelt are likely to lead to long-term decreased river flows in sub-catchments (WorldBank, 2013). Rivers are likely to receive peak flow earlier in the year following preterm snow thawing and increased rain relative to

snow precipitation as temperature rises, therefore affecting dry season water availability (Costello, 2009).

All these predicted climate changes are likely to impact different aspects of quantity and quality of drinking water. Probably the most important impact will be the seasonal loss of water sources due to aridification, salinisation or failure due to increased demand leading to people's reliance on even poorer, more distant water sources. Linked with heavy rainfall, frequent contamination of surface water sources, particularly shallow wells, springs, rivers and ponds, and increased load of contaminants in shallow ground waters, is anticipated. In addition, the capacity of sewer systems and water and waste water treatment plants will be challenged as rainfall events become intense and more frequent (IPCC, 2007). Such contamination is likely to lead to an increase of water-borne diseases. For example, it is estimated that there will be a climate change related increase of 6% in diarrhoea cases in South Asia by 2030 compared with 3% globally (Pandey et al 2010).

Salinity has the potential both to amplify the risk of water-borne disease like cholera as the pathogen responsible has been demonstrated to live longer in saline water (eg. Khan et al, 2011). Salinity has also been directly linked to health impacts like hypertension in pregnant women (Khan et al, 2011). Recent analysis also suggests that malaria and dengue mosquito-vectors possess the capacity to tolerate salinity variations and undergo preimaginal development in brackish waters (Ramasamy & Surendran, 2012). For example, there is potential in coastal areas for the density of salinity-tolerant mosquitoes like Anopheles sundaicus, the vector of malarial parasites, and Culex sitiens, the vector of Japanese encephalitis virus and Ross River virus, to increase as brackish and saline water bodies expand due to sea level rise. Moreover freshwater mosquitoes like Aedes aegypti and Aedes albopictus, vectors of dengue fever, and Anopheles culicifacies and Anopheles stephensi, the vectors of malarial parasites, can adapt themselves to saline water (Ramasamy & Surendran, 2012).More indirectly, saline water also impacts on agriculture leading to livelihood loss and population displacement and industry reducing the economic development potential of some areas, hence challenging development objectives of local regions.

Reduced river flows and increased water temperature will lead to declining water quality as the dilution of contaminants is decreased, less oxygen is dissolved in water, and microbiological activity increases. These effects could lead to major health problems for vulnerable people, especially during drought (Costello, 2009). Due to sea level rise (discussed in the next section) both surface and ground waters in coastal areas are at higher risk of salinization. Water supply systems, from large cities to small communities, are more prone to damage due to exposure to more frequent extreme climate events like storms and floods, therefore may force reliance on unimproved water sources leading to increased water-borne diseases. Greater variability in rainfall also affects water supplies and may lead to an increased demand and investment for storage of water or more use of natural groundwater. For example, rainwater harvesting may become less effective as they are vulnerable to extended dry periods.

The impacts on human health through effects on drinking water are difficult to predict with certainty, and are highly specific to local situations and population vulnerability, but the poorest and the poorest countries and those without adequate resources are likely to be affected most.

1.1.2Climate change and vector borne disease

Vulnerability assessments across the world indicate that climate change will increase the incidence of communicable diseases including vector borne diseases (VBDs). VBD are those diseases that are spread by 'vectors', a term used in epidemiology to mean organisms, often invertebrate arthropods such as mosquitoes, that help transfer pathogens from reservoirs to host, or from host to host. These insects act as an essential bridge of transmission of an infection from one individual to another, or from animal hosts to the human population (Hunter, 2003) In this manner, vectors can transmit a large number of viral, rickettsial, bacterial and parasitic diseases (Kuhn, 2003). Such diseases cause morbidity and mortality throughout the world and pose an extra burden on global health. For example, 3000 million population are at risk and tens of millions of people are infected every year due to dengue (Kuhn, 2003); malaria causes some one million deaths and 273 million cases worldwide each year (Rogers and Randolph 2000; Hales and de Wet et al. 2002; Hay, Guerra et al. 2004), and deserves its place at the forefront of any discussion on vector borne disease.

The distribution and abundance of vector organisms and intermediate hosts are affected by various meteorological factors like temperature, precipitation, humidity, surface water and wind and biotic factors such as vegetation, host species, predators, competitors, parasites and human interventions. The meteorological factors and some of the biotic factors are influenced by climatic conditions. Various integrated modelling studies have forecasted that an increase in ambient temperature would cause increases in the geographical distribution of particular vector organisms (such as dengue-carrying mosquitoes) (Sirbu, Curseu et al. 2009; Hales, de Wet et al. 2002; Raheel, Faheem et al. 2010) although the literature acknowledges that some localized decreases are also plausible. Furthermore, temperature-related changes in the life-cycle behaviour of both vector species and pathogenic organisms such as flukes, protozoa, bacteria and viruses will likely increase the potential transmission of many vector-borne diseases such as dengue fever (Rogers, 2000; Githeko, 2001).

Most vector-borne infectious diseases have a complex transmission cycle and are heavily influenced by many extrinsic and intrinsic factors. Both local and global climate considerations are important in assessing this life cycle. Changes in climate variables along with global warming trends are expected to temper or amplify the emergence or resurgence of many vector-borne diseases. For example, in one study carried out in Zimbabwe, a strong relationship between malaria and altitude was demonstrated, with altitude taken, rightly, to be a good surrogate for temperature (since the average temperature decrease with height was approximately 6.1° Celcius per 1000 metres) (Parmentar, 1999).

Gubler et al. (2001) list a range of possible mechanisms whereby changes in temperature can modify the risk of transmission of vector borne diseases. They include:

- Increases or decreases in survival of vector (through, for example increases in surface water acting as breeding sites)
- Changes in rate of vector population growth (related, not surprisingly, to increase survival as well as improved breeding conditions)
- Changes in feeding behavior (relating to the availability of hosts, being forced into closer proximity with vectors, for example)
- Changes in susceptibility of vector to pathogens
- Changes in incubation period of pathogen

• Changes in seasonality of vector activity
• Changes in seasonality of pathogen transmission

Mosquitoes are quite sensitive to changes in temperature and rainfall, and are among the first organisms to extend their range when environmental conditions become favourable (WHO, 2002). That is, they are highly mobile. Cold temperatures are often the limiting factor in mosquito survival, so any increase in minimum winter temperatures, a common climate change projection, would likely extend mosquito ranges into temperate regions or higher altitudes where they do not survive now.

Although temperature determines the potential range of the mosquito and the disease organism, precipitation principally governs the availability of breeding sites and the overall population of mosquitoes. Thus, the combination of temperature and rainfall changes modified by many other factors such as land use changes, human population densities, and whether exposed populations have any built-in disease immunity will determine how the patterns of mosquito-borne diseases change (Gubler 1998). In some areas, the interplay of these factors will increase disease incidence; in other areas, incidence may decline.

Climatic conditions play a pivotal role in the distribution, degree of endemicity and epidemicity of diseases in an area. Some areas, which have the most favourable conditions of temperature and rainfall, experience transmission of vector-borne disease throughout the year, while in areas experiencing colder months, transmission is seasonal and does not take place throughout the entire year. However these historical patterns may change as average daily temperatures increase, due to increases in temperatures in the cooler periods. Although a suitable climate is necessary for disease transmission, other factors are needed for an epidemic to take place, including a source of infection, vector populations, and a susceptible human population.(Karim, Munshi et al. November 2, 2010). Hence the potential disease impacts of climate variability are difficult to accurately predict, and will be highly dependent on the adaptive capacity of vector control and health systems.

1.1.3 Climate change and heat related health issues

Climate change is expected to increase the frequency, duration and intensity of heat waves across the globe, and this will result in a significant public health burden. The effects of climate change on health will disproportionately affect more vulnerable populations due to increased exposure to heat but with limited capacity to adapt. Older adults, especially those who are chronically ill and socially disadvantaged people, are more vulnerable to health effects related to extreme heat (Kovats and Hajat, 2008) Others may be vulnerable to heat due to increased exposure, for example outdoor workers. For such workers who also have higher levels of physical activity (e.g., construction workers), the health risks associated with extreme heat events will be greater. Successful adaptation strategies will be those that involve local communities and key stakeholders to assist vulnerable populations to reduce heat exposure and improve capacity to adapt to the extreme weather events.

The relationship between global climate change and extreme weather events (particularly heatwaves) is now well established. Climate change is projected to increase global mean surface temperatures by 2–4.5°C with 76% probability, and over 4.5°C with 14% probability, by 2100 (Rogelj et al, 2012). Changes in climate can be linked to changes in the mean, variance or shape of

probability distributions, or all of these. Therefore, a changing climate may lead to changes in the frequency, intensity, duration, and timing of extreme weather (IPCC, 2007, Meehl and Tebaldi, 2004]

Signs of heat-related illness in an individual often begin with heat exhaustion, which, if left untreated, might progress to heatstroke—clinically defined as a core body temperature of at least 40.6°C. Progression to death in an individual with heatstroke can happen rapidly (within hours), and even with prompt medical care, 15% of heatstroke cases are fatal. In many situations, however, heat exposure might not be confirmed as the underlying cause of death, and so heat-related illness is underreported. Heat exposure is a factor that can contribute to exacerbation of many pre-existing health conditions.

Evidence of heat effects in community settings derives from epidemiological studies in which the effect of each heatwave episode or the daily change in number of health outcomes in relation to day-to-day fluctuations in temperature occurring throughout the summer months are assessed. Health effects have been shown to be mostly immediate, occurring on the same day, or within a day or two, of initial exposure. Although in most studies, health effects are modelled in relation to temperature alone or in combination with high humidity as a composite measure, in some, possible synergistic effects of additional weather factors, such as air pressure, wind speed, and cloud cover, are taken into consideration. Air pollution might also increase during heatwaves, leading to possible synergistic effects on health (Hajat et al, 2012).

In Europe, increases in emergency hospital admissions among individuals with respiratory diseases have been noted during hot weather, but not in those with cardiovascular disease or stroke. By contrast, in studies from the USA, heat-related increases were noted in admissions for heart disease, acute myocardial infarction, and congestive heart failure. Reasons for the differences between Europe and the USA are not obvious, but might relate to factors associated with health-service delivery. A consistent increase has been noted in admissions for renal disease in Europe, the USA, and Australia. Increases have also been noted for other conditions, including diabetes and mental disorders (Hajat et al, 2012).

Surrogate outcomes for morbidity that are also sensitive to ambient heat include ambulance transportation, calls to telephone help lines, and despatches by fire departments. As data for some of these outcomes are routinely gathered and available in real time, they might be useful in surveillance for identification of the early public health effects of heatwaves. Their usefulness, though, might be limited by situations in which perceived symptoms, rather than a diagnosis, are the basis of the outcomes (Huang et al, 2013)

Effects of heat have been characterised in various settings. They are stronger early in the summer season, and can vary within a city because of spatial variations in temperature. New epidemiological evidence suggests that a high yearly summer mortality burden might be linked to low mortality rates in the previous winter [Hajat et al, 2012,Rocklöv et al, 2009].

1.1.4 Climate change and extreme events

The severity, frequency and distribution of extreme events are expected to be modified by climate change with many parts of the world expected to experience more frequent or intense events or

both (IPCC, 2012). These events include floods, drought, cyclones and associated storm surges, heatwaves and storms. Despite the contemporary 'all hazards' disaster management approach, different types of events can have different types of impact. Some events like flash - floods and cyclones are rapid, have limited warning and occur only for a short time. Others, like drought, can occur over many years. In 2012, 357 disaster events were recorded. They killed more than 9 million people and impacted more than 124 million people around the world. Of these deaths, 53% were from floods, 27% from drought and 16% from storms (Guha-Sapir, Hoyois, & Below, 2013).

Extreme events can impact on communities in a number of ways. The most obvious impacts relate to the immediate loss of life and injury that occur during the course of an acute extreme event (for example, drowning during a flood or storm surge, injury associated with flying debris during a cyclone) (Mirza, 2003). Depending on the nature of the disaster this may immediately increase the burden on acute health services. Following the immediate impacts, injury, disease and death associated with clean up, contaminated water and food and social disruption may also increase demand for health services and require health action.

Disasters also have the potential to disrupt critical infrastructure. This includes building infrastructure such as health facilities and domestic housing as well as other infrastructure critical to maintaining a functioning healthy community such as power supply, communication, water and waste services and food supplies (World Bank, 2011).

Damage to transport infrastructure affects access to critical life-supporting supplies and to health services. Along with restricting the communication of key health protection messages, the impact on communications can also have impacts on identifying the magnitude and extent of damage and hence the potential for health effects and effective public health response. Damage to housing may impact on water and food supplies and require movement of populations either locally into evacuation centres or outside of the affected area. Such population movement also has health implications relating to temporary supply of water and food, overcrowding and disease spread (Davis et al, 2010).

The implications of damage to critical infrastructure for public health are well understood and in the short term are associated with traditional hazards of water quality, food safety and supply, waste and personal hygiene and subsequent spread of communicable diseases (Davis, et al., 2010; Shoaf & Rottman, 2000). For example, in mid-2010 a flash flood occurred in Bangladesh. Due to transport infrastructure damage, a significant number of families suffered from food crisis in Jagannathpur upazilla in the Sunamganj District. Moreover due to lack of clean drinking water, there was an increase in the number of people (especially children) who experienced sanitation related diseases such as diarrheal diseases and skin infections (IFRC, 2010).

In the longer term, extreme events that impact on critical infrastructure can influence livelihoods impacting on economic security with implications for health and increase potential for temporary or permanent migration (McMichael et al, 2012).

Psycho-social impacts of disasters are also important to understand, plan for and manage following a disaster (Davydov et al, 2010). These can be acute- requiring 'psychological first aid' or be felt for

many years following the event. The mental health impacts of extreme events are the subject of increasing research and policy attention. For example, Australia's most recent climate change and health report includes an entire section titled 'Climate change will affect minds' (Hughes and McMichael, 2012).

Extreme events such as natural disasters significantly hinder development prospects (Hay & Mimura, 2010; Mirza, 2003). For example, the Bangladesh Sixth Five Year plan (GoB, 2013) identifies that poverty alleviation efforts have been undermined by natural disasters, identifying specific districts, for example the coastal belt of Barisal, as requiring special attention due to continued high poverty levels, largely attributed to natural disasters. Therefore, natural disasters not only directly impact human health, but are also responsible for reducing the development gains made in services and infrastructure, by directing resources away from improvements and enhancements and hence limiting climate change resilience.

1.2 Health response to climate change

"Health systems need to prepare for: gradual changes in health outcomes, sudden extreme events, and an extra burden of disease and potential new conditions" (EU, 2013a).

The emphasis of health response is highly dependent on an existing country's development status which influences its general vulnerabilities as well as existing population health status, existing extent and strength of its health system and existing integration of health into high level decision making. When considering the health response, an analysis of the three dimensions of vulnerability is critical to understand what factors are contributing to the impact. As identified by IPCC (2001), vulnerability is a function of exposure, sensitivity and adaptive capacity. In the context of climate change, *exposure* relates to the weather or climate-related hazard, including the character, magnitude and rate of climate variation, *sensitivity* refers to the extent to which health or the natural or social systems on which health outcomes depend are sensitive to changes in weather and climate and the characteristics of the population, and *adaptive capacity* relates to a system's natural, social, human, infrastructure and financial capital, including health system capacity.

One of the key limitations to undertaking more comprehensive health vulnerability risk assessments, planning and developing and then assessing adaptation responses for health is the need for suitable data. In many countries, while data sets exist for some parameters, they are often:

- Not available for long enough periods to understand the relationships with long-term climate change
- Not of sufficient quality to undertake quantitative modelling for sensitive health outcomes
- Not in a suitable form that enable understanding of short-term impacts of climate variability on the variety of climate sensitive diseases of interest
- Not available at a spatial level that matches the local need for adaptation strategy development
- Not collected in a way that allow for targeted adaptation strategies (eg.general injury data following floods, but not about who gets most injured, where they are injured, what type of injury they sustain, what is the outcome of the injury etc.)

- Not co-collected with matched demographic data that assist with more targeted, vulnerability based adaptation strategy.

However, as identified in Section 2, adaptation requires an iterative approach and hence using qualitative data through stakeholder workshops and semi-quantitative methods to prioritize health risks can be a useful starting point. Waiting to develop adaptation plans until suitable data is collected to conduct a risk assessment limits health influence in climate change adaptation action.

Other limitations for developing effective health adaptations as identified by Huang et al (2011) include: uncertainty in projections, financial challenges, limits in technological advancement and dissemination, institutional arrangements that limit scope of collaborative effort and accumulation of evidence about effective adaptation (an important issue, also made clear by BCAS (2010) in the Bangladesh context), limits on social capital at community level, uninformed or inaccurate perceptions of individual risk.

As identified by Hess et al (2012,171) 'public health institutions at all operational scales will need to consciously modify their approaches to both science and practice anticipation of climate change health impacts'. The magnitude, type and priorities given in response to a large extent reflect the existing health burden and the strength of the existing health systems.

1.2.1 Developed country context

In the developed world context, response to the existing climate change health impacts has often been framed by the perspective that climate change impacts have and will continue to primarily amplify existing hazards (Hess et al, 2012). In this context the health system needs to be able to identify changes in existing burdens of disease and manage accordingly within current health systems capacities or by advocating for 'more of the same' as required. This view has led to a relatively slow and non-urgent response to identify, assess and plan for changing health risks associated with climate change in some countries. An alternative perspective – that innovative and new approaches are necessary to respond, require a significant investment in resources and challenge the current paradigm of thinking (Hess et al, 2012).

The lack of health action in some developed countries, also partly reflects the lack of action on climate change in general and particularly climate change adaptation. The reasons for this vary but include lack of political will and leadership, projected small and 'manageable' impacts on health, and a low priority afforded to climate change and health adaptation action in a resource-limited environment.

At a country level, very few developed countries have conducted comprehensive climate change vulnerability assessments or developed related adaptation plans, and even fewer have developed specifically health focused climate change adaptation plans, instead acknowledging the many determinants of health impacts relating to climate change and preferring to integrate health within other thematic areas.

One leading exception to this is the UK, which under its Climate Change Act (2008) is required to conduct a comprehensive risk assessment to climate change and a related adaptation plan every 5 years. This legislative process has driven significant investment in the understanding of the impacts

of climate change in the UK and a valuable assessment of the current policy environment and future opportunities. From a health perspective, the process also required a technical health report that was last published in 2012 (UK Govt, 2012). Its focus is solely on evidence in the UK and, hence reflects the priority issues for that country that appear similar to many other developed countries. It includes chapters on: current evidence and projections, temperature, air pollution, aeroallergens, indoor environment, UV, Flooding, vector-borne diseases, water and food-borne diseases and co-benefits.

The document describes a staged approach to quantitative modelling of climate change and climate sensitive diseases. For example for temperature, stage 1 includes an epidemiological analysis of the relationships between temperature and mortality and stage 2 is a risk assessment based on projections, useful for longer-term adaptation planning. The document also makes extensive use of mapping to communicate both temporal changes and spatial distribution changes.

A 2011 analysis of Australian and international literature on climate change and health risks by Hughes and McMichael (2011) explores climate influences on heat-related mortality and illness, health impacts of other extreme events, air pollution and vector-borne diseases, and to a lesser extent water-borne diseases and food safety and security in Australia. For example it suggests increases in heat-related mortality will outweigh the reductions in cold-related mortality in states such as Queensland and the Northern Territory with 10 times as many deaths predicted by the end of the century compared with no climate change. Researchers also suggest a potential increase in dengue fever prone areas into central-eastern Australia in 2100 from the current dengue risk area of north-eastern Australia. The report also suggests that the intensity of category 3 to 5 cyclones may increase up to 60% by 2030 and up to 140% by 2070. Interestingly it includes an entire section on mental health impacts, identifying the impacts from acute extreme events along with the longer term social impacts associated with climatic changes, for example related to changes in food supply. It also identifies the most vulnerable populations associated with the identified health impacts and provides a small section on health related action.

Like the UK report (2010) the health impacts most focussed upon reflect those typically prioritized most highly in developed countries. Unlike the UK report, the report represents an overview of the existing research literature with no primary analysis on health impacts based on climate projections, nor does it provide any analysis of regional health vulnerabilities.

1.2.2 Developing country context

In the developing world the amplification of existing health risks perspective prevails (see Huynen et al 2013), however, in contrast to the developed world, the existing health risks are already significant for many of the key climate sensitive diseases. Hence climate change, among other factors, is expected to overload the capacity of existing health systems, potentially increasing health burden and reversing health gains made in many countries in recent years. This means that continued emphasis on improving development and reducing poverty, improving health systems and improving existing health status remain an unquestionable priority. The question is then, what are/will be the additional impacts of climate change on human health, who will most be vulnerable to such impacts and in which locations, and how does this increase the magnitude and urgency of resource allocation in reducing such impacts?

Though the development of NAPAs and linking of climate change to the development agenda in the past 10 years has certainly improved consideration of all climate change impacts into high level policy, assessment and adaptation planning in the national and NGO project agendas, the sectors most directly impacted and responsible include water, agriculture and food, with a lack of research and policy assessment for health. In fact, in some countries, including in Bangladesh (NAPA, 2005) and the Philippines (World Bank, 2013) health was not included in the core group of government agencies concerned with high level climate change policy.

Though there have been some very generic reviews of health impacts conducted at a country level, for example, Bangladesh (CCC GoB, 2009) and Indonesia (Haryanto, 2009), very few have been published in the peer-reviewed literature. The Indonesia report provides a general overview of health impacts and identifies what needs to be done from a health adaptation perspective, for example in the areas of: health security, strengthening health systems, health development, evidence and information, delivery of actions and partnership, however analysis of the issues is limited (Haryanto, 2009). More information about the Bangladesh report is provided in Section 3.

One useful published example is that provided by the small Pacific Island Country of Vanuatu. Using a HIA approach, a health vulnerability assessment was conducted and linked to climate change adaptation primarily using a qualitative approach (Spickett et al 2013). Health issues were identified into 4 risk categories. Water-borne diseases and food-borne diseases were assessed as extreme risk, and vector-borne diseases, malnutrition, non-communicable diseases (including mental health), temperature-related illness and occupational related issues were classified as high risks.

In the area of disaster management, globally many responses have been implemented to improve community resilience that ultimately will also assist with adapting to the longer-term climate change phenomenon. For example, improved disaster management arrangements, more national and local coordination and planning, more physical infrastructure to protect vulnerable geographical areas (eg. polders in coastal areas of Bangladesh) and communities from extreme events (eg, provision of shelters) and improved alert systems are all important improvements instituted in the disaster management context.

Responding to extreme temperature events has also been a focus for many countries. Activity has included researching the health impacts of such events, defining such events and developing heat wave public health plans to extreme events that encompass identification of vulnerable populations, community and health sector awareness, health promotion strategies and workplace procedures and protocols. The WHO has recognised numerous regional heat-wave strategies for their effectiveness including Philadelphia,USA (Kalkstein, 2000), Paris, France (Canoui-Poitrine et al, 2006); Ahmedabad, India *(*NRDC Issue Brief, 2013) and Abu Dhabi (Joubert, 2011).

A recent DFID funded project ‘ Communicating the health risks of extreme heat in China’ focussed on 3 particular vulnerable population groups: Elderly individuals, chronic disease sufferers and those in care institutions; workers exposed to intensive heat such as outdoor workers, heavy manual labourers, and kitchen staff and young children, particularly those under five years of age. The project used a literature review of scientific evidence of effects, a review of selected regional heat-wave plans and workshops and focus-group discussions with a diverse range of stakeholders to

generate a resource package which extracts and communicates scientific research findings to potential end-users as a guiding framework and reference material for the development of community specific heat wave response plans.

The European Union has also undertaken considerable work in responding to climate change and health through assessment of health risks, summarised well by the 2010 Declaration – 'Protecting health in an environment challenged by climate change' which calls for:

- Integration of health in all climate change mitigation and adaption measures, policies and strategies at all levels and in all sectors
- Strengthening of health, social welfare and environmental systems and services to improve their responses to climate change
- Development and strengthening of early warning systems and services to improve their response to the impacts of climate change
- Development and implementation of education and public awareness programs
- Mitigation collaboration with health
- Encouraging research and development

Their analysis has also identified the range of health actions and strategies that already consider climate change or that provide opportunity to assist in climate change and health impacts and adaptation assessment (i.e. existing or potential 'mainstreaming') ranging from high level and broad health strategy (eg. EU Health Strategy 2008-2013) to surveillance (eg. network for epidemiological surveillance and control of communicable diseases), to specific health sub-sector protocols (eg. Food safety response mechanisms) and research agendas (eg. EU framework programs for research in relation to health). They also consider health action across three distinct areas, as outlined by their CEHAPIS (Climate, environment and health action plan and information systems) program:

1. Health intelligence and awareness of climate change and health
2. Integration of climate change into health policies with the specific objective to increase health sector and system action on climate change and health
3. Integration of health into climate change related adaptation and mitigation policies – to better aim at population health benefits when developing climate change related adaptation and mitigation measures in a variety of sectors

1.2.3Current research and future research needs

To date research efforts have primarily focussed on identifying current and future health risks associated with climate change (WHO, 2009) and such concerted effort has really only occurred in the past 6-7 years as researchers have started to focus on the health impacts of climate change at a level of resolution beyond general commentaries of identifying pathways for health impacts and broad assessments of vulnerabilities. For example, a small investigation of papers in the peer-reviewed literature accessing the Scopus citation database analysis function using the key words 'climate change and health' in the title, keywords or abstract indicates that since 1997 when publication numbers were in the 30s, published material has increased significantly to a total of 1012 citations in 2012.

However, many of the health impact studies have focussed on generating information to advocate for mitigation or adaptation action or further research, as opposed to directly informing adaptation planning and action, or improving adaptation practice. This limitation of the current health and climate change research focus has been identified in the WHO's summary report of climate change and health research priorities (2009). It calls for research on climate change and health to be undertaken within the overall context of improving global health and health equity, rather than being a stand-alone issue and identifies that more research is required on operational decisions and basing on existing research capacity related to existing environmental health issues such as vector control and air pollution. This focus is consistent with the need to link climate change to development, particularly in the developing country context and acknowledges that in many settings, responding to climate change can build on existing workforce capacity in the environmental or broader public health field.

The key categories and then focus of research within each category is identified by WHO (2009). Example research activities have been included in the key areas of:

i) Assessing risks

- Those relationships that are potentially quantifiable using current methods (eg. climate change and sensitive vector-borne disease)
- Those relationships that are difficult to quantify (effect on food and nutrition or mental health)
- Those relationships that have a long causal chain between climate change and health impacts (eg. effects on population displacement)
- Those relationships that are merging or uncertain (eg. altered risks of asthma or kidney stones)

ii) Identifying the most effective interventions

- Need for systematic reviews of the evidence base for interventions
- Methodological research to improve analytical tools for cost-effectiveness analysis

iii) Guiding health-promoting mitigation and adaption decisions in other sectors

- Improved methods for assessment of the health implications of decisions in other sectors
- Health impacts of climate change mitigation: energy and transport sectors
- Health impacts of climate change adaptation: water, food and agriculture
- Improved integration through settings based research

iv) Improving decision-support

- Stock takes, cataloguing, critical review, pilot testing and revision of current guidelines for vulnerability and adaptation assessments
- Improvement of operational predictions
- Improved understanding of decision-making processes

v) Estimating the costs of protecting health from climate change

- Definition of harmonized methods to estimate costs and benefits
- Assessment of the costs of inaction and the costs of adaptation
- Improved economic assessment of the health co-benefits of climate change mitigation

Importantly, it identifies a priority need to obtain more disaggregated data in order to better identify and describe climate change health risks for vulnerable populations at local levels.

1.3 Section summary

This section has identified the span of health issues associated with climate change including the social pre-conditioning factors that make some populations more vulnerable than others. It provides a summary of climate change and its associations with water and health, vector-borne diseases and extreme events, including heat waves. A comprehensive assessment of relationships was beyond the scope of this review, and other important health issues, were mentioned but not considered in any detail. A key feature of all summaries is the variation in projected climate change impacts and associated variations in predictions in linked health outcomes. The water and health section included a section on salinity and health as this is an emerging area for many parts of the world, particularly those regions with high coastal populations.

National climate change and health vulnerability/risk assessments are scarce. In the developed world context, there are some examples of national reports of health impacts, and the UK provides an example of a comprehensive assessment. The lack of national work in other developed countries may be attributed to lack of political interest, perception of a small health impact, competing health priorities and lack of research focus. The reasons for a lack of national health assessments in developing countries may also include competing priorities, lack of research capacity and lack of data on which to make assessments. However, the WHO funded Vanuatu HIA project provides a useful example of what can be done as a starting point, in a data limited environment.

Climate change and health research is a relatively new field, with a major increase in research activity in the past 6-7 years. However, until recently, much of the research was focussed on quantifying the impacts of climate change on the easily measurable, more direct health outcomes. Such methodology is often limited by the absence of good quality, long term data and fails to adequately frame the problem from a vulnerability perspective and hence limits the utility of the data to advocating for action and more research, rather than informing adaptation strategy and practice. The use of this methodology for national health risk and vulnerability assessments is particularly problematic in developing countries where underlying vulnerability is so critical to assessing impact. The recent WHO research needs publication (WHO, 2009), clearly identifies this limitation and provides a series of research areas and activities to better inform adaptation development and practice. This is a very positive step advancing the health and climate change adaptation agenda.

SECTION 2: VULNERABILITY ASSESSMENT AND ADAPTATION TO CLIMATE CHANGE – GLOBAL GUIDANCE AND PRACTICE

2.1 The adaptation development process

The adaptation development process includes a number of sequential stages and should be seen as an iterative process. The phases include scoping to set context and activity parameters, vulnerability and/or risk assessment, prioritizing health risks, developing an adaptation strategy (which also encompasses prioritization of actions) and then implementation, monitoring and evaluation.

2.2 Global guidance

Much of the climate change adaptation guidance work has focussed on the developing country context where there are global drivers for national climate change adaptation (such as the NAPA process), and where adaptation deficit, characterised by a failure to adapt adequately to existing climate risks, is significant (IPCC, 2007). This has been led by agencies such as the UNDP-UNEP and WHO and supported by the World Bank.

Despite the success of NAPAs in improving awareness of CCA, particularly among national stakeholders (Osman-Elasha and Downing, 2007), a number of limitations in NAPA implementation have been identified. They include: the need for improvement in integration of CCA and development planning, particularly to address population issues which ultimately affect both overall development and adaptation ability, lack of coordination between lead agencies (usually meteorology or environment for climate change adaptation issues) and planning for National Development Plans and a lack of recognition of social dimensions into both short- and long- term adaptation project development (Hardee and Mutunga,2010). Furthermore, the authors identify that the NAPA process itself has led to prioritizing of short-term 'projects' focussed on single sector actions.

Unfortunately, despite national efforts in developing countries to develop climate change adaptation plans, the recognition of the importance of health within these plans has been limited and very few countries have specific climate change and health adaptation plans. Also, many existing NAPAs inadequately cross-reference between thematic areas that impact on health, so some health impacts and associated adaptation responses that are identified are disparate, leading to a lack of health focus during implementation and action. Though this lack of specific focus on climate change and health adaptation planning is not unique to developing countries, such settings have significant pre-existing health issues and inadequate existing health infrastructure and hence the risk amplification of climate change is likely to be higher.

Before providing examples of specific guidance, a series of consistently identified issues, concepts and approaches related to climate change adaptation are provided below.

2.2.1 Linking science and policy and practice

One of the key systemic challenges for climate change adaptation in many developing countries is the incorporation of science into policy. A survey of over 600 developing and developed

stakeholders, 30 informant interviews and six country case studies identified 5 systemic obstacles to improving the science-policy dialogue relating to climate change adaptation in developing countries (Jones et al, 2010). They include:

- Low levels of scientific understanding by policy makers
- Limited openness of politicians to using scientific information
- Limited dissemination of research findings
- Lack of incentives for using scientific information in development policy making
- Lack of institutional channels for incorporating information into policy

Interestingly, the study found that with the exception of health and environment agencies, many ministries failed to use scientific evidence or research to inform policy conceptualisation, formulation or implementation. Despite the lack of power and resources given to these agencies, this finding suggests that health and environment agencies, should be taking a within-government leadership role in developing evidence-based climate change assessments.

2.2.2Links to development

From a developing country perspective, the NAPA requirements established as part of the 2001 Marrakech Accords at the 7th COP of the UNFCC has encouraged a greater consideration of climate change into national planning and strategy. As countries continue to strive to meet their MDG targets by 2015, a strong debate has emerged about the impacts of climate change on development and in particular, the potential for climate change to hinder countries meeting their MDGs in specific key areas of food security, water and sanitation.

It is widely acknowledged that the developing world already has an adaptation deficit and therefore reducing poverty and improving economic opportunities for individuals along with improving institutions, infrastructure and systems will reduce overall vulnerability, and hence reduce the impacts of the emerging climate change stressor. As identified by the Stern Review (pg iv) '*if individuals and communities are empowered by development and rendered less vulnerable overall, they will be better able to adapt to climate change*'.

Hence the development frameworks that exist in many countries, such as National Development Plans and Poverty Reduction Strategies provide a good starting point for integrating emerging challenges such as climate change. However, it is argued that while linking climate change adaptation to development is critical, climate change adaptation is an additional related activity and funds should not be diverted from development activity to climate change responses (eg. WHO et al, 2011; Ahmad, 2010).

2.2.3 Framing adaptation

According to Jones et al (2009) the way in which climate change development is framed, physical or social, can lead to quite different policy priorities. The initial global focus has been on understanding the environmental dimensions of the climate change problem by better refining the spatial and temporal resolution of the projections and identifying environmental systems and regions, the economic costs of adaptation and the technological inputs and costs to adaptation (WHO et al, 2013). However, in a developing country context, the links between development and adaptation

risks are seen as strongly complementary (Ahmad, 2010) indicating a broader focus on population and systems vulnerability.

The two CCA approaches that are often considered include (eg Nguyen et al, 2013; Fussel, 2009):

1. A focus on managing specific climate change hazards or risks (eg. vector-borne diseases, food security, diarrhoea). While this emphasis may provide a good starting point, it fails to understand and acknowledge the multifaceted and complex links that are involved and the approach may not be able to easily accommodate the need for locally relevant adaptation actions.

2. A vulnerability perspective that identifies the causes of higher vulnerability and lower adaptive capacity by focussing on measures to reduce poverty and other non-climatic factors that make people vulnerable- this requires a mainstreaming approach that is further discussed in Section 2.2.6

The social dimensions discussion paper (WHO et al, 2013), points out the critical importance of integrating social dimensions into change adaptation process, identifying that the social dimensions of climate change are currently not well understood or addressed. It points out that people are not only the victims of climate change (and hence social dimensions are necessary in consideration of exposure and sensitivity dimensions) but are also important agents for climate change adaptation. The discussion paper provides 9 key policy recommendations:

- Complement global and regional climate analysis with social impact assessments to properly identify socioeconomic climate change 'hotspots'.
- Develop more frequent and better informed social impact assessments.
- Promote inter-ministerial policy coordination/dialogue.
- Ensure safeguards are in place to protect the interests of the most vulnerable when designing and implementing climate solutions.
- Invest in human capital.
- Ensure that the large infrastructure changes necessary for low-carbon growth do not exacerbate societal inequities.
- Include social dimensions-responsive budgeting in climate finance at both national and global levels.
- Ensure that climate funding is additional to current official development assistance.
- Identify research gaps and prioritize areas in which to bolster research.

Achieving the right balance for framing climate change adaptation to consider both physical and social dimensions will remain a challenge in the future.

2.2.4 An iterative, evolving approach

It is important to acknowledge that national and sub-national climate change adaptation assessments will be conducted for different purposes, framed in different ways, develop from different starting points, and be informed by differing types of data.

For example, the policy and decision context (identified through the scoping step – refer to Section 2.4) needs to be clearly identified (Fussel, 2008). Is it about awareness raising, identifying priority areas for adaptation and drawing on work of others, or are the health risks well understood and

adaptation is focussed on costs and benefits of adaptation? Kovats et al (2003) suggest that climate change adaptations can take many forms including:

- A list of adaptation options without evaluation
- Estimation of health benefit or effectiveness of specific adaptation strategies
- Evaluation of specific adaptation strategies (eg. Using cost-effectiveness analysis)
- Policy analysis that addresses the feasibility of specific adaptation strategies

For numerous reasons, the climate change adaptation process should be seen as iterative and analysis conducted using a tiered approach. For example, important risks are first identified qualitatively and then prioritized to a smaller set of risks, for which more detailed analysis can be conducted on future risk and adaptation options (Fussel, 2008).

Furthermore, successful adaptation acknowledges that adaptation is an evolving process (EU, 2013b) and that actions need to evolve to respond to new knowledge of risk and evaluation of approaches and actions. For example, the UK has conducted 3 health assessments since 2002 following each of the revisions of climate change projections. To support this evolution, implementation frameworks that include clear monitoring and evaluation guidelines are critical.

2.2.5 Community based adaptation

Overwhelmingly, the literature indicates that successful adaptation is context specific and hence must have a local component and draw on the knowledge of local people (Ahmad, 2010; UN Water 2009; UK Government, 2013). As identified by SEAR WHO (2012, pg 23), '*Coping strategies have been part of people's lives since life first came into existence. The question, though, is whether such traditional strategies are robust enough to cope with the current demands, or whether people need to develop new adaptive mechanisms?'*

The importance of community in adaptation has been recognised through the explicit development of the Community Based climate change adaptation approach. Community based adaptation takes the approach of adaptation as development (framed in a 'vulnerability context –see 2.2.3) and considers that adaptation is local and place based. It also acknowledges that adaptation strategies must be generated through participatory processes involving local stakeholders, rather than being restricted to impacts-based scientific inputs alone (Ahmad, 2010). Figure 2.1 shows where community based adaptation fits within a comprehensive climate change adaptation framework.

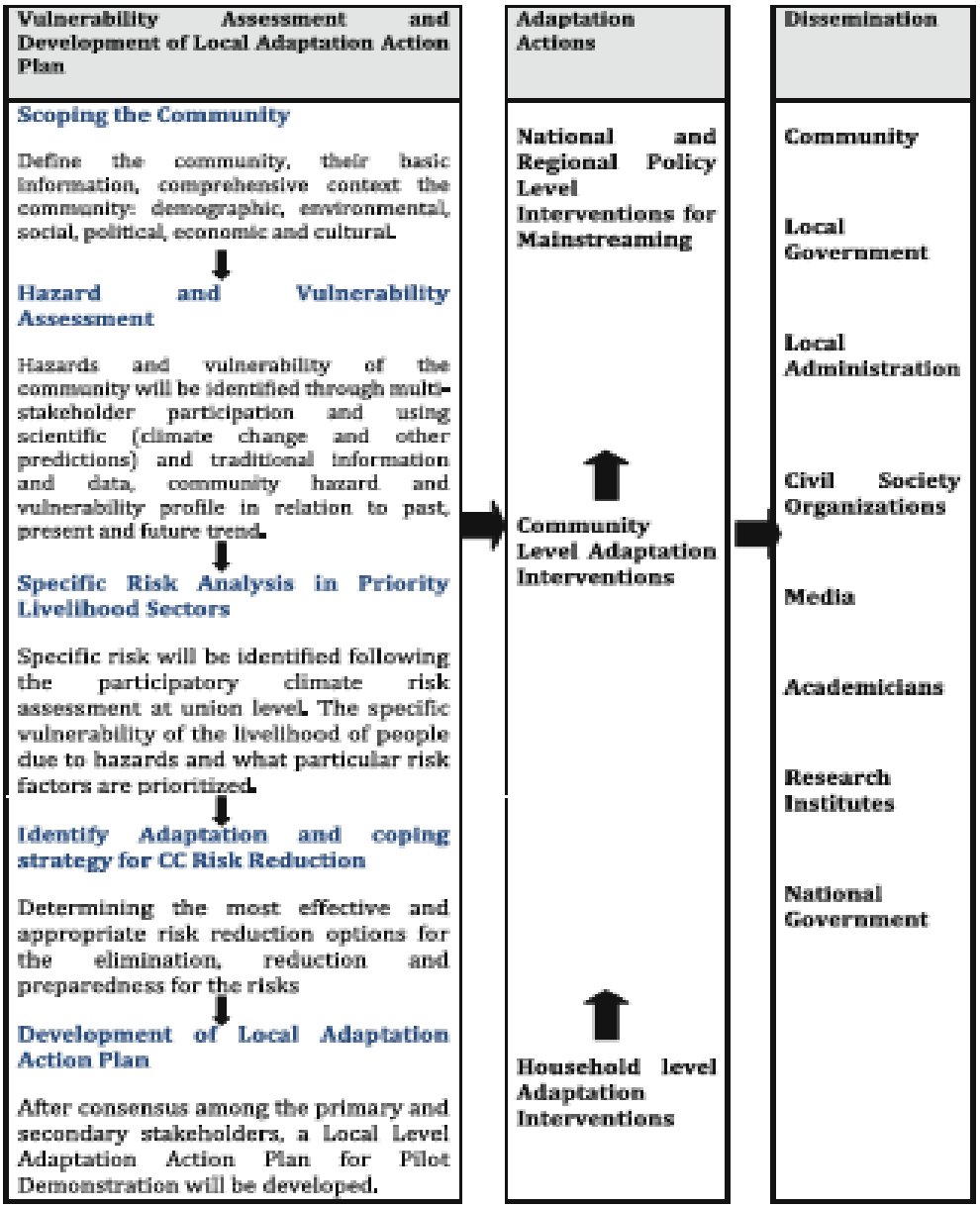

Figure 2.1 – The different layers of adaptation (Source: Rashid and Khan, 2013)

Ahmad's (2010) analysis of community based adaptation to climate change in Bangladesh provides useful insights into the challenges for the approach. Key challenges relate to:

1. **Sustainability**–community based adaptation projects typically have a high dependence on donors and external agencies; imposed interventions not grown from an indigenous need; community organizations that remain weak and have low participation
2. **Effectiveness**– a piecemeal approach due to a lack of coordination and integration amongst the key policies and institutions; interventions remain often palliative in nature; reactive rather than proactive.
3. **Finance** – difficulties in generating local funds; inadequate flow of fund for community level activities

2.2.6 Mainstreaming adaptation

Despite the multiple and diverse climate change adaptation activities being implemented across the globe, and particularly in developing countries where they are predominantly funded by local and international NGOs, a project based approach may not produce the scale of results that is needed. Hence formulating national adaptation plans and climate change strategy must be supported by a cross-cutting, integrated policy approach (Hardee and Mutunga, 2010). This 'Mainstreaming adaptation' approach is the focus of global agencies such as UNDP and UNEP and the approach has been identified as a key pillar to successful adaptation in the EU context (EU 2013b). The UNDP document on 'Mainstreaming climate change adaptation into development planning: a guide for practitioners' (2011) provides useful guidance for policy makers and practitioners about how to integrate adaptation planning, implementation and monitoring into existing decision-making processes. The document includes useful sections on 'finding entry points and making the case', 'mainstreaming climate change adaptation into existing policy' and 'meeting the implementation challenge' and throughout includes boxed case examples and questions to prompt discussion and identify opportunity.

UNEP-UNDP (2011) describes 3 levels of intervention for climate change adaptation including:

i) Strengthening the development base (reducing the adaptation deficit and striving to reduce overall vulnerability)
ii) Promoting mainstream adaptation measures by considering climate change into government decision-making
iii) Specific adaptation measures not in i) or ii)

The key challenges identified for mainstreaming include:

1. Raising awareness and building knowledge about climate change, vulnerability and adaptation.

2. Making the issue central in government – not just within the Environment portfolio which in many countries has limited power within whole of government decision–making. Finance or planning ministries are more likely to have access to more substantial finance, coordinate and influence the work of other agencies (Jones et al, 2009).

3. Involving sectors and sub-national bodies – reflecting the interactive nature of climate change on human society and the diverse vulnerability to climate change within countries, climate change adaptation cannot be successful without strong multi-sectoral collaboration, both horizontally and vertically.

4. Linking local-level impacts to national level responses – national responses MUST be informed by, and be able to consider the diversity of local issues.

5. Meeting the implementation challenge – this remains a key challenge in many developing countries requiring persistence to overcome difficulties in coordination, and reporting and monitoring across a diverse range of sectors, actors and activities.

6. Strengthening institutions and capacities sustainably at every level – national and sector institutions need to be able to develop integrative policy frameworks that ensure effective coordination and implementation and sub-nationally, institutions need to be able to identify their local vulnerability and adaptation needs and respond using guidance provided by national and sectoral policy.

7. Ensuring and sustaining political will - a considerable challenge, particularly in developed countries where successive governments in power can have differing interests and approaches to responding to the climate change evidence, partly driven by political ideology and influenced by powerful industry bodies who fail to acknowledge the existence or causes of climate change.

In order to improve success of climate change adaptation the UNDP-UNEP (2011) call for consideration of climate change into policy processes at a national level (eg through development planning), sectoral level and sub-national level (to reflect local differences). 4 action areas are provided to assist decision-makers with developing an adaptation approach:

a) Start with no or low-regret measures
b) Evaluation with economic or non-economic approaches
c) Promoting co-benefits with development
d) Building flexibility and factoring in long-term consequences

Furthermore, prioritizing adaptation actions is an important step and should include such considerations as:

- How effective is the measure in reducing vulnerability?
- To what extent would it help in reducing the impacts of extreme events?
- What are the economic costs and benefits?
- What is the level of regret?
- Is the measure feasible? Are there important limiting factors for implementation and sustainability, such as lacking legal, financial, technical and institutional resources?
- Are there secondary or cross-sector impacts, externalities (maladaption) or co-benefits?
- How effective is the measure under different future climate scenarios? To what extent does it address short-, medium- and/or long-term climate change impacts?

Key to the success of climate change adaptation will be effective monitoring and evaluation of processes and activities (EU, 2013b). UNDP-UNEP identifies the need for a national monitoring system, appropriate models of financing strengthening institutions and institutionalising flexibility.

European Union Guidance

The European Union has produced two very useful documents – one which focuses on climate change adaptation and human, animal and plant health (EU, 2013a); the other more generic on development of adaptation strategies (EU, 2013b). The EU guidance is unique as it is guided by the learnings from its diversity of member states – highly developed to less developed, with highly diverse populations, geography and climate change impacts. It acknowledges that differing contexts will have differing resources, differing amounts and quality of data, differing decision-making systems, differing existing health status and differing opportunities for adaptation development.

Its guidance is practical, provides links to more detailed guidance for further information and includes many examples of projects and activities and lessons learnt. It identifies the aspects of good adaptation practice as:

- having a sectoral focus – reflecting need for cross government adaptation working groups to drive implementation
- adopting mainstreaming
- stakeholder involvement
- communication and awareness raising
- an evolving process

It also summarises the limiting factors for successful adaption as:

- absence of considerations for cross-border impacts
- limited engagement in the preparation of detailed risk and vulnerability assessments
- lack of action plans – much of the work done could be summarised as awareness raising or laying the groundwork
- lack of monitoring and evaluation – particularly development of indicators
- lack of funding

Others challenges identified include uncertainty, political commitment, and lack of human and financial resources.

It provides detailed guidance on their 6 step approach as identified in Figure 2.2:

- Step 1 -Preparing the ground for adaptation
- Step 2 - Assessing risks and vulnerabilities to climate change
- Step 3 - Identifying adaptation options
- Step 4 - Assessing adaptation options
- Step 5 - Implementation
- Step 6- Monitoring and evaluation

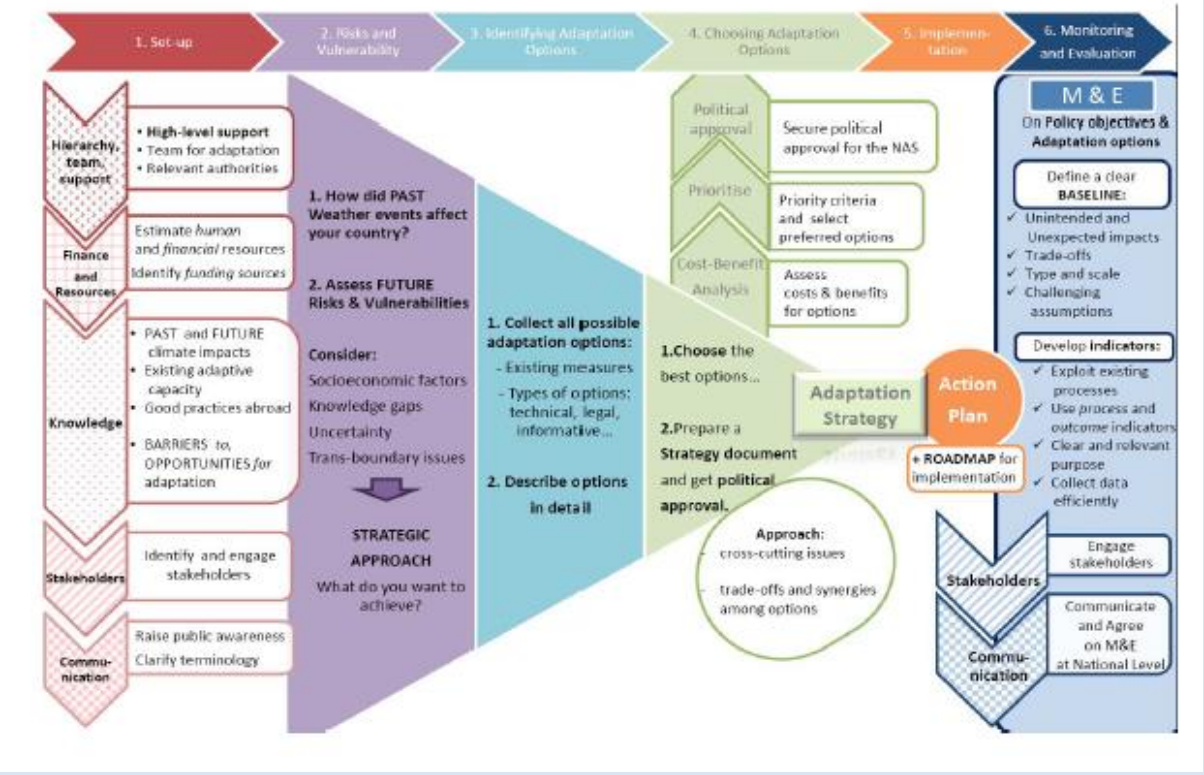

Fig 2.2 – The EU 6 step Adaptation approach (Source EU, 2013b)

2.3 Water focused guidance

Water resources management affects almost all aspects of the economy, in particular health, food production and security, domestic water supply and sanitation, energy and industry and environmental sustainability. As identified by UN Water (2009) there are strong and well understood linkages between water and health and climate change.

Despite the significant improvements in water supply and sanitation coverage in many countries, the relevant water MDG achievements are threatened by climate change and some agencies suggest that if potential climate change impacts were fully considered, projected achievements against the MDG 7 would be revised downwards (WHO/DFID, 2009). This makes water a high priority for climate change adaptation.

The UN Water analysis (2009) provides a short but clear overview of the issues facing the water sector to respond to the issue of climate change. It suggests that there are 5 key areas of opportunity for water related climate change adaptation. They include:

1. Planning and applying new investments (for example, reservoirs, irrigation systems, capacity expansions, levees, water supply, wastewater treatments, and ecosystem restoration).

2. Adjusting operation, monitoring and regulation practices of existing systems to accommodate new uses or conditions (for example, ecology, pollution control, climate change, population growth).

3. Working on maintenance, major rehabilitation and re-engineering of existing systems (for example, dams, barrages, irrigation systems, canals, pumps, rivers, wetlands).

4. Making modifications to processes and demands for existing systems and water users (for example, rainwater harvesting, water conservation, pricing, regulation, legislation, basin planning, funding for ecosystem services, stakeholder participation, consumer education and awareness).

5. Introducing new efficient technologies (for example, desalination, biotechnology, drip irrigation, wastewater reuse, recycling, and solar panels).

Effective water adaptation response will need both non-structural and structural measures, acknowledging that non-structural measures are often more flexible. It will also require assessments of adaptation actions for unintended impacts on other sectors that can undermine overall goals (i.e. 'maladaption'). The ability to identify and address maladaption is particularly important for the environment and health sectors. Such issues will require engagement across sectors to draw on not only the expertise of engineers, infrastructure planners and water technology experts, but also those professionals with expertise in community behaviour change, community engagement, surveillance of impacts, environmental health systems, epidemiology and risk assessment and risk communication.

As described in Section 2.2.4, adaptation should be iterative and hence there should be constant modification of climate change adaptation measures for water based on monitoring and feedback. This will require actions to be built on learning-by-doing principles, particularly drawing on learnings from local projects and knowledge. As an urgent starting point, the UN document calls for 'systematic assessments of climate change resilience of all utilities, including rural water and sanitation programmes' (2009. pg 8).

This statement raises the question- what is 'climate change resilience'? The insightful document produced by WHO and DFID (2009) answers some of the questions about the notion of climate change resilience from a water perspective. It argues that despite uncertainty in water related projections at a regional level, in specific parts of the world, for example in Asia where flooding and surface water reliability will be impacted by climate change, there is sufficient knowledge to inform urgent change in policy and planning for water.

It discusses the notion of designing and implementing technologies and strategies that can be adapted to cope with multiple threats, not only climate change. It also recommends that adaptation questions need to be considered for two distinct time horizons – the short-medium term – eg. for the 2020 climate projections- how can existing technology cope?, and in the longer term, eg. 2030 and beyond - how to design and invest to meet future demands?

A potential methodology for identifying resilience for water supply and sanitation systems involves categorising technologies according to their climate change resilience, taking account of both vulnerability to climate changes (determined by engineering and environmental factors) and adaptive capacity (i.e. the ability for the system to be adjusted or managed so as to cope in response to different climate conditions). The assessment used information from the published literature, a

series of semi-structured interviews and a web-facilitated questionnaire survey to firstly categorise climate change resilience of drinking water and sanitation technologies. On this basis it also recommended suitable technologies across the WHO regions, based on existing issues and predicted climate change in each region. The analysis then produced example tables of vulnerability, impacts and adaptation options for specific systems eg. pit latrines. An example table is provided by Figure 2.3.

Conventional sewerage and pit latrines: vulnerability, impacts and adaptation methods

VULNERABILITY	IMPACTS	ADAPTATION METHODS			
		CAPITAL EXPENDITURE	OPERATIONAL EXPENDITURE	MONITORING	SOCIO ECONOMIC TOOLS
Utility piped water supplies – flooding increases					
Water intakes may be left exposed as water levels fall.	Highly turbulent water flows in rivers after heavy rain may damage intakes.	Design water intake to accommodate varying water levels (for example floating booms). Develop groundwater sources where feasible. Design and construct overflows for source reservoirs to prevent failure . Strengthen river intakes to withstand more turbulent flows.	Maintain spillways and channels in good order. Develop, implement and update water safety plans.	Early warning system installed.	Disseminate early warnings. Update and disseminate evacuation procedures. Increase frequency with which emergency procedures are practised.
Tubewells - water availability decreases					
Increased use of viable wells causes increased wear and tear and increased water demand. Damage to the well or borehole increases the risk of contamination entering the water source.	Public health risk from consumption of the water.	Determine the degree of vulnerability by investigating linkages between climate and groundwater, e.g. residence times.	Ensure high levels of maintenance on in-demand wells.	Sanitary survey. Monitor the ability of wells to cope with current droughts.	Implement discussions with other users of aquifer such as irrigation farmers and private well owners to manage the resource cooperatively.

Figure 2.3 – Conventional sewerage and pit latrines: vulnerability, impacts and adaptation methods (WHO/DFID, 2009)

This methodology provides a useful basis for analysis of climate change resilience of existing infrastructure at a local level, taking into account local conditions, population structures and existing and future needs, but also provides useful general information about the types of infrastructure and their vulnerabilities to differing climatic conditions.

In addition to methods such as these for identifying vulnerabilities and comparing system resilience, emerging tools such as Water Safety Plans (WSP) provide an opportunity to 'mainstream' climate change resilience into design and operation of water supply and sanitation systems at a local area. As the WSP process is based on a risk assessment approach, with appropriate guidance, climate resilience could be included as a standard factor in the process.

One of the notable issues raised by WHO/DFID (2009) is the high vulnerability of community based systems. They suggest that these types of systems are associated with high rates of failure and contamination, and while these types of systems are inherently more resilient to external changes like climate change, climate change will also increase stress on community management processes. Therefore a key area of research activity must be to critically evaluate current community management approaches and identify better processes.

2.4 Health focused guidance

The health sector is not unfamiliar with many of the challenges that climate change presents. The concept of multiple health impact pathways through which varying factors influence population health has been described for other contexts and the multi-determinants of health approach to public health assessment and policy development is not a novel concept. Public health practitioners recognise that many public health impacts are generated by, or fall within the regulatory responsibility of other sectors and hence working with other sectors is commonplace and an expected part of public health practice. Because of this, public health must play a strong advocacy role, as public health concerns are often not a key priority of these other sectors. The uncertainty associated with projections into the future has also long been acknowledged through the public health risk assessment and communication approaches that have been particularly necessary in the environmental health field and more recently the public health disaster management area.

As the global emphasis has shifted to that of climate change adaptation and as more of the earlier climate change projections are being realised, more guidance is now being provided on developing adaptation strategies and plans. Though the climate change community has adopted its own terminology, many of the steps involved in developing adaptation can be directly compared to existing approaches. In the health discipline for example, approaches such as Health Risk Assessment, Health Impact Assessment and to a lesser extent Needs Assessment have established a range of steps that parallel those of climate change vulnerability assessment and adaptation assessment and plan development. All approaches include a scoping component that clearly identifies the boundaries of the 'project' making it clear the focus of the assessment, governance structure, the key stakeholder inputs at various stages, the space and time dimensions etc. All approaches include a 'profiling' dimension that clearly identifies the characteristics of the community at risk and how those characteristics might change over time, a risk identification step that identifies the hazards in the particular location for a particular population, an assessment step that requires an analysis of the hazards in the context of the population at risk and identifies priorities for response and management and a risk management step that identifies existing risk management approaches and identifies what is necessary to change to address the assessed prioritized risks. The climate change and health vulnerability and adaptation process adds a new

dimension of prediction, which is present in the HIA approach, but which requires examination beyond short-term projections.

Fussel's 2008 review provides an excellent starting point for exploring the guidance on climate change vulnerability and adaptation assessment for health. It identifies key issues necessary to consider, complexity of adaptation decision-making and identifies some existing guidance documents and their strengths and weaknesses. Fussel (2008) identifies 3 key guidance documents of value following consideration of a range of six existing guidance documents using a set of 14 criteria: clear procedural structure, flexible assessment procedure, prioritization of assessment efforts, identification of key information needs, inclusion of key stakeholders, choice of relevant spatial and temporal scales, balanced consideration of current and future risks, management of uncertainties, policy guidance in the absence of quantitative risk estimates, prioritization of adaptation actions, mainstreaming of climate adaptation, cross-sectoral integration, disease-specific methods and tools and assessment of key obstacles to adaptation.

Fussel's review concludes that no single document comprehensively addresses all important issues from a health perspective, but recommends a blend of 3 key approaches - WHO (Health) and UNDP-GEF Adaptation Policy Framework (APF) and UK Climate Impacts Program (UKCIP). The reason for this blended recommendation is that the UKCIP and the UNDP-GEF Adaptation Policy approaches provide the most useful guidance on adaptation policy assessments (UKCIP is developed country focussed, while the APF is most applicable in a developing country context), though neither have specific consideration of health. On the other hand, though the WHO guidance is more applicable to health, it fails to adequately consider the information needs of adaptation stakeholders.

WHO have led the way in providing guidance on assessment of health impacts of climate change with its 2003 publication of 'Methods of assessing human health vulnerability and public health adaptation to climate change" which was designed to provide early guidance to national governments on climate change and health assessments. This early document provided some initial definitions of health vulnerability and adaptation, details on assessment frameworks and methods and some specific examples of assessment in the areas of air pollution, heat, food, water and vector-borne diseases, with limited mention of some less direct impacts relating to food security and the concept of vulnerable populations. This global guidance on health and climate change has since been updated by the 2010 document 'Protecting Health from Climate Change Vulnerability and Adaptation Assessment''. Global guidance on adaptation has been further extended by the publication of the 2013 WHO economic assessment of health costs of adaptation (WHO 2013). The HIA approach has been used in a limited number of circumstances (eg. Western Australia and Vanuatu), providing a useful step-by-step approach to assessing climate change risks and identifying adaptation options.

WHO (2010) recognise that a risk management approach to climate change is necessary and that this approach needs to be iterative given the rapidly changing information and knowledge on climate change and other stressors affecting identified health outcomes. Its purpose is to provide basic and flexible guidance to guide national and sub-national assessment of current and future vulnerability to inform adaption. Consistent with other global guidance documents (Eg. UNEP-UNDP, 2009), it advocates that such an approach needs to be integrated into existing programs that address health

risk and assist in strengthening health systems. The assessment guidance takes a qualitative approach that acknowledges the limitations associated with collecting quality quantitative data. As identified, for example, by Spickett et al (2013) an assessment of priority health risks and subsequent adaptation strategies can be carried out at a national level and provide timely and useful information to decision-makers without detailed quantitative information.

The WHO guidance document (2010) is divided into 4 key sections that outline the steps in conducting a vulnerability assessment and adaptation assessment with a focus on health. A schema for the overall process is included in Figure 2.4

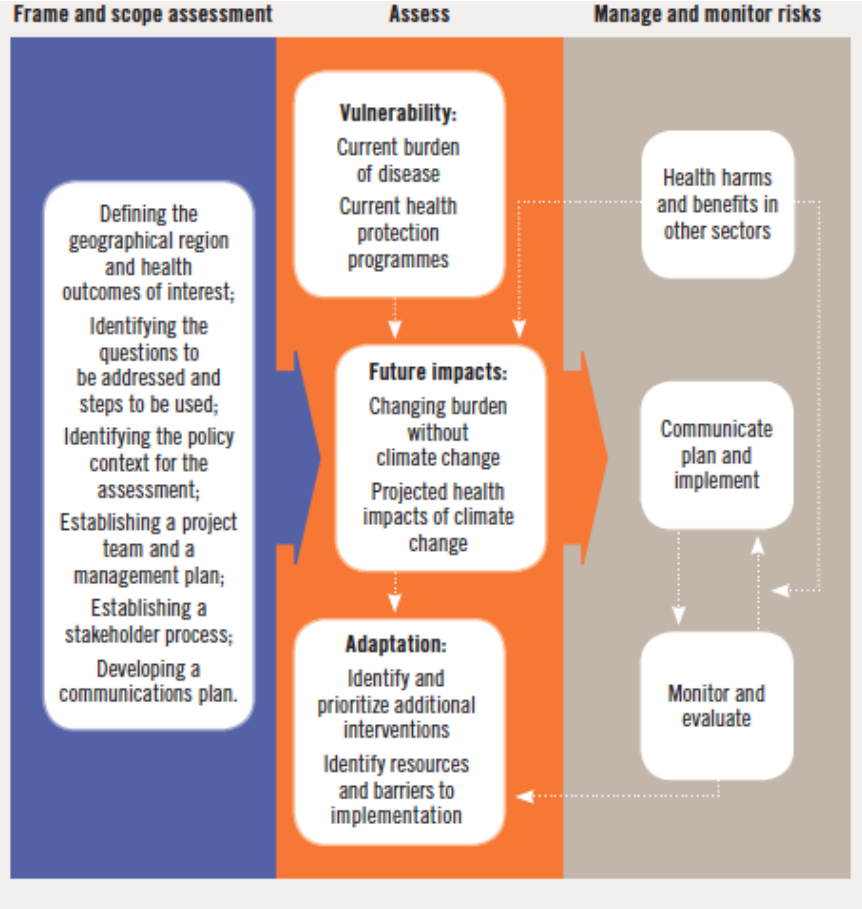

Figure 2.4 – Overview of the WHO climate change and health vulnerability and adaptation approach (WHO 2010).

The steps include:

i) Framing and scoping of the assessment

This is a critical part of the assessment, necessary to set the boundaries for the assessment process. It acknowledges the differing starting points for a health and climate change assessment: for example, much about the health risks may be known and so the focus may be on identified changes in the future and adaptation option. On the other hand, the assessment may focus on identifying the likely changes and determine possible consequences.

As highlighted in the document, understanding the policy context for the assessment is important for framing and determining scope. Why is the assessment being conducted? How will the generated information be used and by when and by whom?

As identified by Fussel (2008), the assessment may take a hazards approach (eg. what type of hazards are of most interest – eg. rainfall changes leading to extreme events) or a vulnerability approach (eg. what makes a particular country/community most vulnerable to climate change). Fussel (2008) suggests that a vulnerability approach is more appropriate in a developing country context where many 'external' factors influence climate change and it is critical that they are explicitly considered within the scope of the assessment. Choosing and agreeing on a particular frame for the assessment is critical for moving forward to address the climate change and health impact challenges faced.

The health dimensions of climate change are impacted by a complex and interacting set of determinants that require multiple and often different stakeholder involvement for both assessment and adaptation stages. Identifying which stakeholders to engage, when and for what purpose is a very important part of the process and good guidance is provided by WHO on this aspect (2010).

ii) Conducting the vulnerability assessment and adaptation assessment

Detailed information is provided on conducting these assessments including examples from around the world. The steps involved include:

- Establish the baseline conditions by describing the human health risks of current climate variability and recent climate change and the existing public health policies and programs to address the risks
- Describe current risks of climate-sensitive health outcomes including the most vulnerable populations and regions
- Analyse the relationships between current and past weather/climate conditions and health outcomes
- Identify trends in climate change-related exposures
- Take account of interactions between environmental and socioeconomic determinants of health
- Describe the current capacity of health and other sections to manage the risks of climate-sensitive health outcomes

To assist with describing the current capacity, the document provides a series of questions:

- What is the management structure for the programme? This information is necessary to identify constraints and opportunities for modifying the programme.
- What human and financial resources are available? Cataloguing these assets is important when planning additional policies and programmes.
- How effective is the programme in controlling the current health burden? Less than optimal effectiveness may be the result of limited human and financial resources, limited laboratory and material supplies, limited coordination among partners, administrative inefficiencies,

and other factors. Addressing this question should include evaluations of overall effectiveness, particularly of programmes serving vulnerable populations and regions.

- How robust are core health system functions (such as human resource planning, disease surveillance, and emergency preparedness and response) to extreme weather events? This is important for identifying existing gaps that may be exacerbated by a more variable climate.
- How might proposed changes to the programme in the next 5-10 years affect its ability to address relevant climate-sensitive health outcomes?

III) Understanding future impacts on health

WHO (2010) recommends that both quantitative and qualitative approaches are appropriate for predicting future health risks from climate change and provides some detailed guidance on the differing methods, their utility in different contexts and their limitations. One of the key issues for this stage is identifying the time period for analysis.

iv) Prioritizing and implementing health protection when adapting to climate change

The document provides some useful recommendations for adaptation plan methodology for health including the use of a risk management matrix that helps to prioritise risks to focus adaptation and includes example criteria to aid in the prioritization process. Criteria include: approximate costs of the intervention, benefits to health and other sectors from intervening (*co-benefits*), feasibility to implement within existing services or system (*mainstreaming potential*), potential harm from any intervention (*maladaption*), potential barriers or obstacles, opportunities for implementation. Of course the criteria used to assist in setting priorities will be dependent on the goals and scope of the assessment.

Throughout the document, case boxes are used to provide examples and provide some insight into how specific methods/issues have been considered or applied in different contexts. It provides a diversity of methods that acknowledge the diversity of quantitative data quality and availability in many settings with examples ranging from the use of qualitative storylines with appropriate caveats to complex and detailed quantitative modelling. The document provides a much needed and important section on health system capacity and resilience, linked to health system strengthening which is so critical to understanding climate change vulnerability and capacity to adapt. It provides a series of questions that could be used to assess capacity and performance of existing health programs.

Drawing on the guidance from WHO (2010) the South East Asian Region of WHO has provided specific guidance to its member states through its "Regional strategy for protecting health from climate change" (2012). It provides some useful, detailed guidance on vulnerability assessment and some practical suggestions/assistance in developing national health action plans.

The document provides an analysis of information requirements, the differing types of vulnerability assessment that could be undertaken and the differing scoping aspects to consider (eg. health problems/diseases to be assessed, policy context that support or should support adaptation,

geographical region and population selected for assessment and their characteristics and relevant infrastructure and institutional arrangements).

It articulates public health measures necessary for system strengthening: surveillance and information systems, existing programs strengthening, improving community engagement through health promotion, public health input into building design, research, sharing of learnings, workforce capacity, health service assessment and collaboration. Furthermore, it describes the health-sector infrastructure assessment requirements, so critical to understanding health system vulnerability. Such an assessment includes human resources, resilience of physical structures, adequacy and appropriateness of logistics, community involvement in managing primary health care facilities, and efficient functioning of hospitals.

The document provides some useful examples, mainly from the disaster risk reduction field, of potential for intersectoral collaboration, which is a consistent theme throughout the vulnerability and adaptation literature. Opportunities include:

- Cost-effective approaches to and tools for reducing risks due to disasters and climate change
- Sharing experiences in climate-proofing and DRM among stakeholders and investing accordingly
- Promoting efficient migration through development of infrastructure and arrange for basic services and amenities for migrants (including health care)
- Ensuring demographic, gender and socioeconomic based equity in adaptation and DRR programs through participatory approaches
- Instituting air, water and ecosystem governance mechanisms
- Formulating policies and practices that involve all public and private stakeholders (including community organisations and community representatives).

From an adaptation perspective, the document reinforces many points provided by general adaptation guidance outlined in Section 2.1:

1. Climate change-related interventions need to be ***mainstreamed*** (within health), explore new mechanisms and tools and be integration within and with other sectoral and development programs

2. ***Localisation*** of adaptation is critical – this means that local information is essential to prioritize vulnerability and relevant adaptation options

3. Strong ***cooperation*** is necessary between producers of, and users of, climate information 'services'

4. Linkage with ***poverty alleviation and environmental protection*** through formulation of laws and regulations and supportive policies is necessary for successful adaptation

5. ***Monitoring*** of adaptation efforts in other sectors is important to maximize co-benefits and minimize maladaption potential.

Finally, the document provides a valuable section on research, monitoring and evaluation and review and identifies some key activities that the health sector should lead/engage in within this part of the iterative adaptation process.

A Health Impact Assessment approach was adopted to develop Vanuatu's climate change and health adaptation plan (Spickett et al 2013). The assessment of health vulnerability, issues prioritisation and corresponding adaptation predominantly used a qualitative approach, facilitated by experienced public health practitioners and drawing on the experience and insights of stakeholders. The approach included the use of a semi-quantitative risk management matrix approach (likelihood and consequence assessment) to identify and prioritize health risks from climate change and identified adaptation options from 9 categories of adaptation measures: legislative or regulatory, public education or communication, surveillance and monitoring, ecosystem intervention, infrastructure development, technological/engineering, medical intervention, research/further information.

Criteria for identification of priority adaptation measures were applied to identify priority adaption actions for each key priority health issue along with six cross-cutting issues of:

- Increased capacity both in human resources and equipment and other support;
- Further information on the health impacts of climate change, including incorporation of these considerations into the training curricula of health professionals in Vanuatu;
- Community education from primary school onwards on the potential health impacts of climate change and the need for adaptation strategies;
- Improved collection, collation, storage and analysis of data on health status in the community;
- Inter-sectoral collaboration; and
- Improved standards and better enforcement of current regulations.

The criteria included: relevance for Vanuatu, current capacity of vulnerable groups/regions, and how adaptation could be implemented in Vanuatu.

This HIA approach was based on the widely accepted HIA steps outlined by WHO (2003) and provided a straightforward step-by-step approach to identifying and prioritizing health risks for climate change, then identifying and prioritizing adaptation actions. By taking a predominantly qualitative approach, it overcomes the data availability and technical capacity challenges that some countries face and provided a set of actions in a relatively short time frame useful for decision-makers (a 1 year project). A similar approach was also used by the Australian state, Western Australia. This approach provides a useful starting point, on which more comprehensive and quantitative evidence based assessment can be based in future iterations.

Monitoring and evaluation of adaptation actions is a common theme of many global guidance documents (eg. EU, UNDP, WHO). In response to this, WHO are developing a practical tool to test the success of adaptation interventions to reduce vulnerability – a 'Vulnerability reduction assessment' tool. This tool is a mechanism designed to track results of adaptation activities or projects using a set of indicators related to reduction of vulnerability and improvement of adaptive capacity of communities. It has a particular focus on the health sector and is designed to be applied to obtain views of a range of stakeholders of the effectiveness of an adaptation activity or

intervention throughout the life of the project. Its development is timely, given the multitude of project level interventions, particularly WASH-related, currently being implemented to build climate resilience in many developing countries.

2.5 Global Practice

Comprehensive and specific health-focused adaptation strategies in developed countries were difficult to find. This could be attributed to the small projected changes in health impacts related to climate change, current maturity of existing health systems and existing low health burdens, compared to many developing country counterparts, particularly for climate sensitive health issues. These issues along with a lack of political interest in climate change, contributes to climate change adaptation being a low priority for public health policy makers. The absence of documents may also reflect the difficulty in accessing them from standard databases, as many countries may not make their documents available on the World Wide Web, and others may not produce their documents in English.

However, numerous countries and states of countries have developed comprehensive climate change adaptation plans that either have a defined health component or include health as a consideration within specific thematic areas. Their emphases reflect their differing stages of development and their variation in key climate change impacts. Some are high level policy documents with a lack of detail on actions, while others include both policy and comprehensive actions. Some contain specific chapters on vulnerable populations, others include regional assessments and some contain useful examples of existing adaptation activity and projects as case examples or case studies (eg EU, 2013a,b).

As identified in Section 1.2, the UK has set a high standard with the development of a very comprehensive climate change national adaptation program. The document is structured into 5 thematic areas: built environment, infrastructure, healthy and resilient communities, agriculture and forestry and natural environment, plus two implementation settings: business and local government and has drawn heavily on previous national assessments of risk. Each thematic area has its own vision, introductory section and is organised into Focus Areas that include an objective(s), existing national and local frameworks and specific actions and identified responsible agents/authorities to address the priority risks for each focus area. Importantly the timing for implementation/action is included.

The health and resilient communities theme draws on the evidence from the climate change health risk assessment (Vardoulakis and Heaviside(ed), 2012) and includes good cross-referencing with other themes and between the focus areas within the theme, 'acknowledging that many of the solutions will require action beyond the health sector'. Cross-cutting objectives included fall into two categories: 'raising awareness and building capacity' and 'making the case for action'.

Though Australia has conducted a national climate change and health assessment (Climate Commission, 2011) and through the National Climate Change Adaptation Research Facility (NCCARF), research needs for adaptation and some adaptation projects have been carried out across sectors,

no government endorsed national adaptation plan exists. However, Australian states/provinces provide a variety of examples of climate change adaptation frameworks and plans.

Western Australia's Climate Change Adaptation plan (WA Govt, 2012) is a high level strategy document with no specific actions included. It includes both mitigation and adaptation considerations, reflecting a co-benefits approach and advocates for integration of climate change into planning processes and infrastructure risk assessment as examples of mainstreaming. The health section includes consideration of vulnerable regions, current knowledge of climate change and health impacts, public health training, monitoring and management for pests and diseases, behaviour change and has strong linkages with disaster management.

The Victorian plan (Vic Govt, 2013) is consistent with its Climate Change Act 2012. It does not specifically describe the range of climate impacts but rather has an adaptation and resilience focus and strong linkages to disaster management. It identifies the need for partnerships and identification of roles and responsibilities of all stakeholders. It makes use of case studies to highlight existing adaptation activity and projects and has a useful 'regional snapshots' section that assists decision-makers at a regional level to make adaptation decisions relevant to their region and provides examples of existing adaptation activity within that region. While there is no dedicated health section within the document structure, some health case studies are provided, eg. on the integration of public health and wellbeing into municipal public health plans through linked up legislation and on heatwaves and vulnerable communities.

The South Australian plan takes a very positive approach to climate change adaptation– its title is "Prospering in a changing climate – a climate change adaptation framework for South Australia' (SA Govt, 2012). It takes a regional approach and for every impact area identified, it identifies existing adaptation activity and opportunities. It describes clearly the roles and responsibilities of various stakeholders. One of its 4 key objectives is: resilient, healthy and prosperous communities. It examines adaptation across 12 sectors, with community health and wellbeing the first sector and water resources the second. It provides some useful guidance on implementation.

In developing countries the NAPA process has provided a platform for climate change adaptation awareness and the beginnings of strategy development. However, for numerous reasons, including a lack of implementation and monitoring of existing activity, the progress against NAPAs and correspondingly developed strategic plans is difficult to ascertain.

From a health perspective, an analysis by Manga et al (2010) indicates that while 39 out of 41 NAPAs indicated health impacts of climate change, only 9 of these 39 had a comprehensive health-vulnerability assessment and of the priority projects identified only 11% focus on health.

Though it does not have a specific health focus, a strategic climate change action plan has been developed for the Philippines based on a very comprehensive analysis of the scientific and socio-economic evidence, the policy and institutional environment and the public expenditure and financial management context (World Bank, 2013). The scope and methodology are quite detailed and the analysis identifies the complexities and interactions involved in climate change adaptation in

a developing country context, providing a useful example of how a well-resourced assessment can be undertaken.

The Philippines document has a key emphasis on mainstreaming and identifying institutional entry points; it discusses the issues around lead decision agencies, their influence and power, the relationships between key agencies and key policies, the limitations of models of governance established for climate change in the Philippines and stresses the need for prioritizing and operationalizing climate change adaptation.

Its analysis of the current situation in the Philippines indicates that the key climate change policy and development plan are only partially aligned and that implementation of the national climate change adaptation plan is being incorporated into the work programs of all climate change agencies as they are revised, but not in a systematic fashion. One of the key reasons for this is the absence of targets and reporting requirements in the national climate change plan and limited guidance for prioritizing of actions or urgency. Related to this absence of indicators is the absence of a monitoring and evaluation system. *Interestingly, despite climate change agencies defined as those whose primary goals are vulnerable to climate change risk or have a high potential for mitigation, the health agency is not included in this agency listing.*

Another important point identified for the Philippines is the lack of institutional capacity and technical capacity and guidance. The example provided is the challenge for transforming national policy into local policy that has limited the integration of climate change action into local development plans. As well as this limited vertical integration, capacity deficit has also limited horizontal coordination between departments and agencies.

Another worthy point raised is the identification of the need for a common vulnerability assessment framework for prioritizing climate action, with the important caveat that the framework used should not be too technical such that it can be easily used by agency staff.

2.6 Section Summary

This section provided a description of some of the useful global guidance and health based guidance available for climate change adaptation. It also described briefly how some countries have approached climate change adaptation planning through a review of their climate change adaptation plans and an insight into some of the methodologies used. Given that climate change and health and water issues remain a priority for many parts of the developing world, a small section on water issues, and specifically building climate change resilience into drinking water and sanitation systems was also included, based on the WHO/DFID material.

Overwhelmingly the literature points to the overarching need to link climate change adaptation to developing countries' development agenda, recognising that climate change impacts threaten to undermine development achievements and that many climate change adaptation issues are about building more resilient systems which aligns well with the development goal of strengthening systems.

The other very common feature of most guidance was the important of mainstreaming adaptation. The examples provided on mainstreaming climate change and health into high level policy documents in the EU context provides a useful starting point. While this will of course need careful analysis and resourcing, mainstreaming adaptation will ensure that climate change issues are integrated into usual planning and program implementation practices. Of course there are many challenges that need to be overcome for effective mainstreaming to occur. Particularly important issues such as improved within and between stakeholder collaboration, for example around information exchange, coordination of information, decision-making as well as appropriate staff training and capacity building.

The relationships between national, regional and local governments will also need to be improved – this improved relationship must build on the fact that effective adaptation requires local engagement and decision-making, and that advice and support (financial and training) must be provided by national governments to assist in identifying and assessing community vulnerability and identify opportunities for adaptation at a local level.

An important part of the adaptation development process is prioritizing risks for further adaptation analysis as well as prioritizing adaptation actions. In the absence of high quality, long term data that assists with quantitative understanding of existing and future risk, a good understanding of vulnerability and risk can be developed and health risks prioritized, through qualitative methods with careful of the right balance, depth and breadth of engagement with the diversity of stakeholders involved, an achievable scope, clear methodologies and good facilitation.

Lastly, common to all guidance is the need for monitoring and evaluation of implementation. A clear implementation framework that clearly articulates roles and responsibilities for agencies for adaptation tasks with timeframes, clear monitoring, evaluation and reporting requirements will be critical to successful adaptation. Emerging tools to assess vulnerability reduction at the project level (eg. WHO's Vulnerability Reduction Assessment tool) are being developed and will be necessary to complement national level monitoring and evaluation processes.

Many guidance documents indicate that the adaptation development process should evolve over time and hence as new information on projections are provided, new research and analysis is conducted, staff capacity develops, and monitoring and evaluation outcomes are reported, then adaptation strategy can become more comprehensive and consider more sophisticated assessments (eg. cost-benefits) of adaptation options. A high priority should always be the adoption of no-regrets, win-win adaptation.

This section provided some examples of how countries are considering climate change adaptation. While very few have specific health adaptation plans, some have attempted to integrate health into thematic focus areas. Some have taken a regional vulnerability approach, profiling and prioritizing issues at a regional level and many have provided case examples to showcase existing adaptation activity. The analysis of the Philippines climate change adaptation policy and institutional review undertaken by the World Bank (2013) provides useful insights into the need for integration of climate change into development processes, the need for horizontal and vertical integration, human capacity and financial constraints, the need for strong leadership and well-defined and resourced

institutional arrangements and the development of vulnerability and adaptation tools that can easily be used by the government sector.

SECTION 3 – HEALTH IMPACTS OF CLIMATE CHANGE AND CLIMATE CHANGE POLICY AND STRATEGY IN BANGLADESH

3.1 Introduction

Bangladesh has been identified as one of the most climate change vulnerable countries in the world (World Bank, 2013). The key contributing factors to this include large areas of coastline exposed to cyclones and associated storm surges, flooding and sea level rise, high populations living in and relying on coastal activities for their livelihood, high reliance on agriculture, rapidly expanding urban areas with existing service deficit. Furthermore, Bangladesh's vulnerability to climate change is significantly increased by its existing development stage, with the national percentage of individuals living in poverty estimated to be 31.5% in 2010 (GoB, 2013).

Despite its continuing large-scale poverty issues, Bangladesh has made commendable progress in eradicating poverty and hunger. Between 1992 and 2010 there was a 45% reduction in poverty from 56.7% to 31.5%. During the same period the annual rate of reduction in incidence of poverty was 2.47% against the MDG target of 2.12% in Bangladesh. These achievements contribute to corresponding improvements in increased life expectancy and lower fertility rate. The estimated figures suggest that the MDG target of halving the population living below the poverty line (from 56.7% to 29.0%) was achieved in 2012. However, attaining food security and nutritional wellbeing as well as reducing income inequality and the low economic participation of women remain major concerns (GoB, 2013).

Bangladesh has already met several other MDG targets such as attaining gender parity at primary and secondary education, reducing the under-five mortality rate, containing HIV infection with access to antiretroviral drugs, the number of children below five sleeping under insecticide treated bed nets, detection and cure rate of TB under DOTS. In addition, Bangladesh has made remarkable progress in reducing the prevalence of underweight children, increasing enrolment at primary schools, lowering the infant mortality rate and maternal mortality ratio, improving immunization coverage and reducing the incidence of communicable diseases (GOB, 2013). Though numerous important health goals have been achieved, inequality remains with for example, under-five mortality rates.

Malarial deaths in the country have been reduced significantly with major interventions for malaria control including expanded quality diagnosis and effective treatment of malaria cases; promoting universal use of long lasting impregnated nets (LLIN) and insecticide treated nets (ITN) in the three hill districts; and an intensive mass awareness campaign for prevention and control of malaria which is making a difference (GOB, 2013). However, meeting the target for access to safe drinking water in rural areas is an existing challenge (GOB, 2013) and this is a serious concern in the context of changing water supplies resulting from a changing climate.

Despite the ongoing challenges, Bangladesh has a long history of 'adapting' to climate related extreme events (BCAS, 2010) and in recent times has significantly improved its natural disaster response through modernising early warning systems, developing shelters and evacuation plans,

constructing coastal embankments, maintaining and improving coastal forest cover and raising local community awareness (Haque et al 2012). As reported by Haque et al (2012), in the past 30 years Bangladesh has managed to reduce deaths and injuries from cyclones with a 100 fold reduction in the number of deaths from the 2007 severe cyclone 'SIDR' compared with cyclone Bhola that devastated Bangladesh in 1970. Despite these important improvements underpinned by overall health and development gains and positive achievements within the disaster management context (Cash et al 2013), consistent with other developing countries, Bangladesh's general vulnerability to any environmental or other stressor remains high.

Acting on a better, more comprehensive understanding of health impacts, through adaptation processes is further challenged by a range of issues, not unique to Bangladesh. These include:

- Deficits in awareness and understanding of health impacts both within the health sector and in other agencies,
- Limited comprehensive understanding of concepts of vulnerability and differential impacts across and within communities,
- Lack of capacity in methods of assessment of vulnerability, risk prioritization and adaptation development,
- Institutional issues associated with silos of responsibility with limited cooperation across agencies, and
- Inadequate working relationships between tiers of government.

3.2 Existing climate change knowledge (from research) and activity

3.2.1 Climate change projections for the future

For Bangladesh, several generic methods have been applied to develop climate change scenarios. In the early stages, without appropriate models and modelling facilities, projection of climate scenarios was based on 'expert judgments'. Then scientifically more rigorous and acceptable scenarios were developed from the computer assisted Atmosphere-Ocean Global Circulation Models (AOGCM). Since the early 1990s several attempts have been made to generate climate change scenarios by using General Circulation Models (GCM). The results of validated ensemble model runs are shown in the Table 3.1 (Agrawala *et al*., 2003). Regional Climate Models (RCM) are the latest development to predict climate change scenarios (Ahmed/CCC, 2006).

The unpublished report on Vulnerability and Adaptation Assessment on climate change related health risks prepared by Ministry of Health and Family Welfare (MOH&FW, 2011) used the latest version of the Regional Climate Model system (RegCM 4) and MAGICC/SCENGEN 5.3 software modelling for temperature and rainfall projections. Both the models estimated a steady increase in temperatures for Bangladesh during 2030-2060, with little inter-model variance. Various models show that the mean annual temperature will increase by 0.8 -1^{o}C by the year 2030 and another 0.5 -1^{o}C by the year 2060. These projections are consistent with observations provided in Table 3.1.

Table 3.1: GCM projections for changes in temperature and precipitation for Bangladesh (Agrawala, 2003)

Year	Temperature change (°C) mean (standard deviation)			Rainfall change (%) mean (standard deviation)		
	Annual	DJF	JJA	Annual	DJF	JJA
Baseline average 2030	1.0 (0.11)	1.1 (0.18)	0.8 (0.16)	3.8 (2.30)	-1.2 (12.56)	+4.7 (3.17)
2050	1.4 (0.16)	1.6 (0.26)	1.1 (0.23)	+5.6 (3.33)	-1.7 (18.15)	+6.8 (4.58)
2100	2.4 (0.28)	2.7 (0.46)	1.9 (0.40)	+9.7 (5.8)	-3.0 (31.6)	+11.8 (7.97)

While a decrease in monthly average maximum temperature is anticipated for months other than those of the monsoon, average minimum temperature will rise in all months. During the monsoon period monthly average maximum temperature will increase (MOH&FW, 2011).

In the World Bank study, the state-of-the-art climate model projections of the Coupled Model Intercomparison Project phase 5 (CMIP5) shows that over the South Asian continent, including the Bangladesh land area, significantly higher average warming is expected in a 4^{o}C world (RCP8.5) than a 2^{o}C world (RCP2.6). In a 4^{o}C world, northern Bangladesh will shift to new climatic regimes, with the monthly temperature distribution moving 5–6 standard deviations toward warmer values (World Bank, 2013). For the Indian subcontinent, the multi-model mean of all CMIP5 models projects that warm spells, beyond 90th percentile, will be at least four to five times longer for RCP8.5 (150-200 days) than RCP2.6 (30-45 days) (World Bank, 2013).

In Bangladesh more than 80% of the annual precipitation comes during the monsoon period. Most of the climate models suggest an increase in precipitation during the summer monsoon because of low-pressure system enhancing rainfall resulting from a warmer atmosphere over land than that of over oceans (MOH&FW, 2011). The latest generation of models (CMIP5) estimates overall increases of approximately 2.3% per degree of warming for summer monsoon rainfall. In addition, an increase in intra-seasonal monsoon rainfall variability for the period 2050–2100 of approximately 10% for 3.8^{o}C warming in RCP 8.5 is projected (World Bank, 2013). As projected in most modelling studies, increases in inter-annual and intra-seasonal variability of rainfall will lead to future increase of frequent years with above-normal monsoon rainfall and years with extremely deficient rainfall; more rainfall during the wet season, an increase in the number of dry days and droughts; and an increase in the number of extreme precipitation events (World Bank, 2013).

Within all regions, intensity and frequency of extreme events like tropical storms, floods and droughts will increase due to changing rainfall patterns (Callow et al., 2011). However it is noteworthy that large uncertainties still persist in GCM projections of spatial distribution and magnitude of the heaviest extremes of monsoon rainfall in South Asia region (World Bank, 2013).

It is also predicted that cyclones may penetrate further inland and cyclone High Risk Areas are likely to increase in size resulting from the associated increases in wind velocity and storm surge height (Tanner et al., 2007). It is expected that the existing cyclone High Risk Areas (HRAs) of 8900 sq km will increase by 35% and 40% in the 2020s and 2050s, respectively and that the total population exposed to cyclone High Risk Areas is likely to increase. Currently about 8.3 million people live in cyclone HRAs and, based projections of future population density, this will increase to 14.6 million in the 2020s and 20.3 million in the 2050s(Tanner et al., 2007).

Spatial variability

There remain significant differentials in income and poverty levels in rural and urban areas of Bangladesh. For example in 2010 the percentage of the population living in poverty was 35.2% for rural areas and 21.3% for urban areas (GOB, 2013). Inequality within urban areas is also a major issue with poverty and infrastructure differentials between formal and informal settlements (Jabeen and Johnson, 2013). Bangladesh is also a geographically diverse country potentially leading to differences in all three key determinants of vulnerability: exposure (differences in environmental change), sensitivity (differences in population structures and health status) and adaptive capacities (differences in access to infrastructure, resources and community capacities) requiring at least regional consideration of climate change and health vulnerability (CCC, MoEF, 2009)

Temporal variability

Detailed knowledge of the existing contribution that climate and other co- factors and stressors make to the current health burden is limited. This makes projections of health impacts associated with climate change in the medium to long term very challenging

In addition, long term issues associated with water and food security, loss of livelihood and population movement to urban areas will also present significant issues for public health in Bangladesh and will require ongoing engagement by the health sector into planning and decision-making for strategy and action.

3.2.2 Health impact assessments and research

At a national level there have been three studies to provide information on the impacts of climate change in Bangladesh. In 2006, a very general assessment of climate change impacts and vulnerability was produced by the CCC and CDMP departments within the GoB (Ahmed, 2006). The report describes the computer models used to make projections of environmental changes and provides a very limited and general sector by sector description of impacts. The document provides useful baseline data about Bangladesh and its existing vulnerabilities that may relate to climate change. It includes a good description of water issues including types of floods, droughts, salinity ingress and provides a series of maps to help to spatially identify vulnerability based on water characteristics for example. It identifies the many and strong links between climate change and water issues, suggesting this should be a strong emphasis of policy response. The analysis makes many recommendations including the need for mainstreaming, the need for an overarching body that has power over other ministries and a more integrated approach to water management. An assessment of the uptake of these recommendations may be a worthwhile area of activity.

This document provides useful environmental and geographical baseline information on which impacts can be assessed. Such information is critical for assessing health impacts and adaptation responses as it provides information on the first of the 3 key issues for vulnerability assessment – exposure. However, climate science is an evolving field and projections can be updated regularly. Hence projected mid to long term impacts will continually need to be refined on the basis of updated projections.

In 2009, the climate change cell unit of DG Environment reported on an assessment of the possible health impacts of climate change on human health in Bangladesh with the purpose of assisting policy makers and planners to formulate viable adaptation policies, strategies and actions. In order to investigate impacts on climate sensitive disease in 3 different climatic zones: Rajshahi, Manikganj and Satkhira, time series data was collected on key environmental parameters and climate sensitive diseases including water-borne diseases, vector-borne diseases, skin diseases and mental disorders. Malnutrition was also examined as were emerging climate sensitive conditions of Nipa virus and Kala-azar. In addition focus group discussions were conducted in the communities to identify community perceptions about climate changes, links to health and those most sensitive to the health impacts (CCC, 2009).

Results indicate that the communities perceived there to be noticeable changes in climate parameters, identifying women and children as the victims of increases in climate-related diseases. Climate parameters were related to diarrhoea, skin diseases, kala-azar and malnutrition (CCC, 2009).

The study found that existing health care capacity was low, suggesting existing adaptive deficit, with issues such as lack of skilled health professionals, lack of medical equipment, insufficient medicines, lack of capacity to provide hospital admissions, lack of doctors, non-existent or inadequate data recording systems. A series of recommendations were made on the basis of the assessment including: better surveillance, improved climate-sensitive disease data, improved training for health professionals, awareness programs in the community to build resilience, improving water supply and sanitation management, protection of water resources and improvement of hygiene practices (CCC, 2009).

A key limitation of the study that was identified was the absence of time-series data on some climate sensitive diseases and the short time periods available for others, making quality time-series data analysis challenging.

The scope of health issues considered was increased in the national health vulnerability and adaptation assessment study (IEDCR, 2011). Its objectives were to identify vulnerable populations, regions, existing policies and programs and research gaps for a range of climate sensitive diseases. It analysed the relationship between climate variables and water borne disease, vector borne disease, cardiovascular disease, mental health and extreme weather events and discussed some of the observed and projected health impacts of climate change in Bangladesh.

Quantitative methods were the primary method for this study, though some qualitative methods were used to verify the results with key stakeholders, gain a better understanding of the

relationships and to identify other non-climatic influences on health outcomes. However, the report didn't discuss these qualitative findings in much detail.

Data availability was a major constraint identified and the authors suggest that for a large scale study in the future more comprehensive information is necessary for developing an adaptation plan. Mainstreaming health in mitigation and adaption strategies, capacity building for health professionals, health services, particularly mental health and water-borne diseases were identified as requiring special emphasis in the future.

The report doesn't clearly articulate the process involved or strength of stakeholder's contribution. Though this study aimed to assess the relationships for the whole country, in reality, climate change impacts and adaptation capacity varies from region to region and is highly dependent on exposure, sensitivity and adaptation capacity, considerations that are largely absent in this study. The study depends heavily on secondary data however the data quality and quantity (spatially and temporally) for many of the parameters is limited.

The study design used did not accommodate well other influencing factors on climate sensitive diseases, nor did it consider well the regional or local differences in the exposure, sensitivity or adaptive capacity to climate change, hence restricting the findings' utility to inform adaptation. However the findings could be used to assist with the prioritization task that must be undertaken in order to inform any national health adaptation plan.

Recently there has been other limited published research on climate change and specific health issues for Bangladesh including water salinity and health, poverty and health issues in urban settlements, population awareness, perceptions and coping strategies for climate change and extreme events impacts.

Water salinity

An emerging climate change related issue in Bangladesh is water salinity. A recent study conducted in the Dacope sub-district in Bangladesh reported that drinking water alone contributed to daily consumption of sodium up to 16g in the dry season, which was significantly higher than the daily recommendation level of 2g of dietary sodium intake. This consumption was linked with a higher proportion of hypertension in pregnant mothers in the dry season (12.20%) compared to the wet season (5.09%). Hypertension in pregnancy has potential adverse effects on maternal and foetal health, including impaired liver function, intrauterine growth retardation, and preterm birth (Khan et al., 2011).

Reproductive health

A recent research report by Eminence (2013) highlights the reproductive health impacts of climate change in Bangladesh and identifies the related policies, gaps and opportunities for improvement. It reviews the literature available predominantly from NGO reports in developing countries, reviews the existing policy environment and conducts a study in a number of communities to identify reproductive health impacts and issues related to climate change, including an analysis of existing reproductive health services and service access. Importantly it focuses on the impacts on health

services, an area that is missing from much of the mainstream literature on climate change and health.

A diagram of the potential pathways through which climate change influences reproductive health in Bangladesh based on the literature review is provided in Figure 3.1.Particular issues identified through a review of the grey literature include:

- Increased miscarriage rates and premature births.
- Deliveries in facilities without adequate hygiene and trained support
- Increased physical strain due to increased workload (eg for food and water supply)
- Reduced food intake
- Increased sexual violence
- Increase rates of UTIs and other infections
- Reduced access to birth control

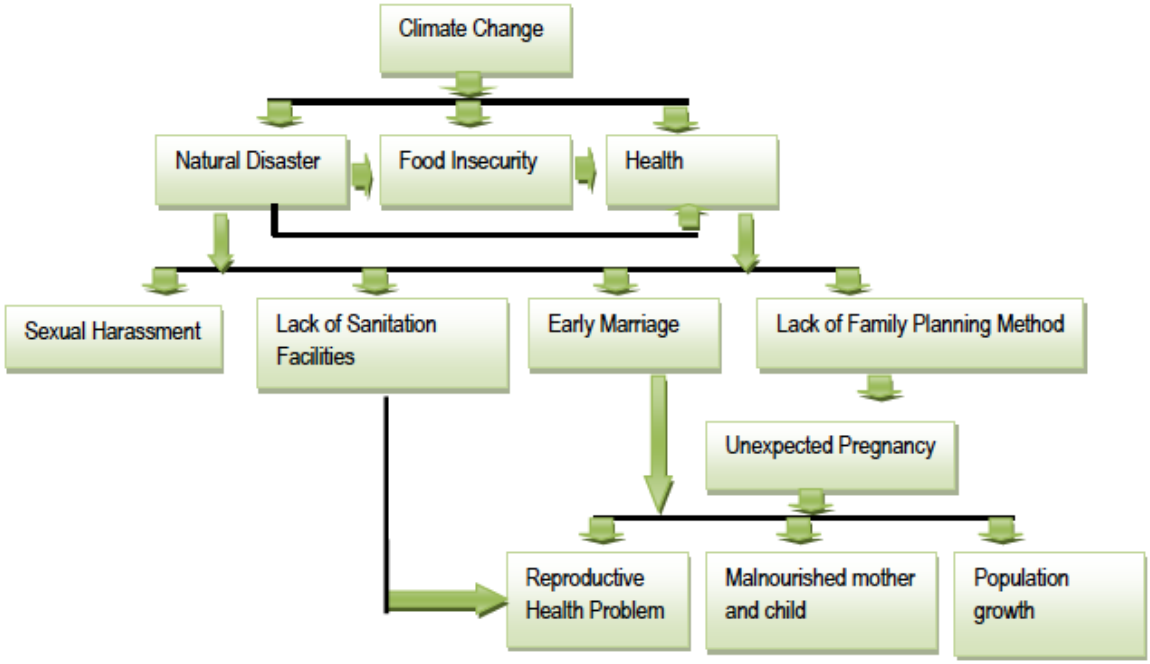

Figure 3.1 – Potential reproductive health issues and impacts associated with climate change

Following the results of the study, a more comprehensive assessment of indirect health impacts was also identified and is provided in Figure 3.2

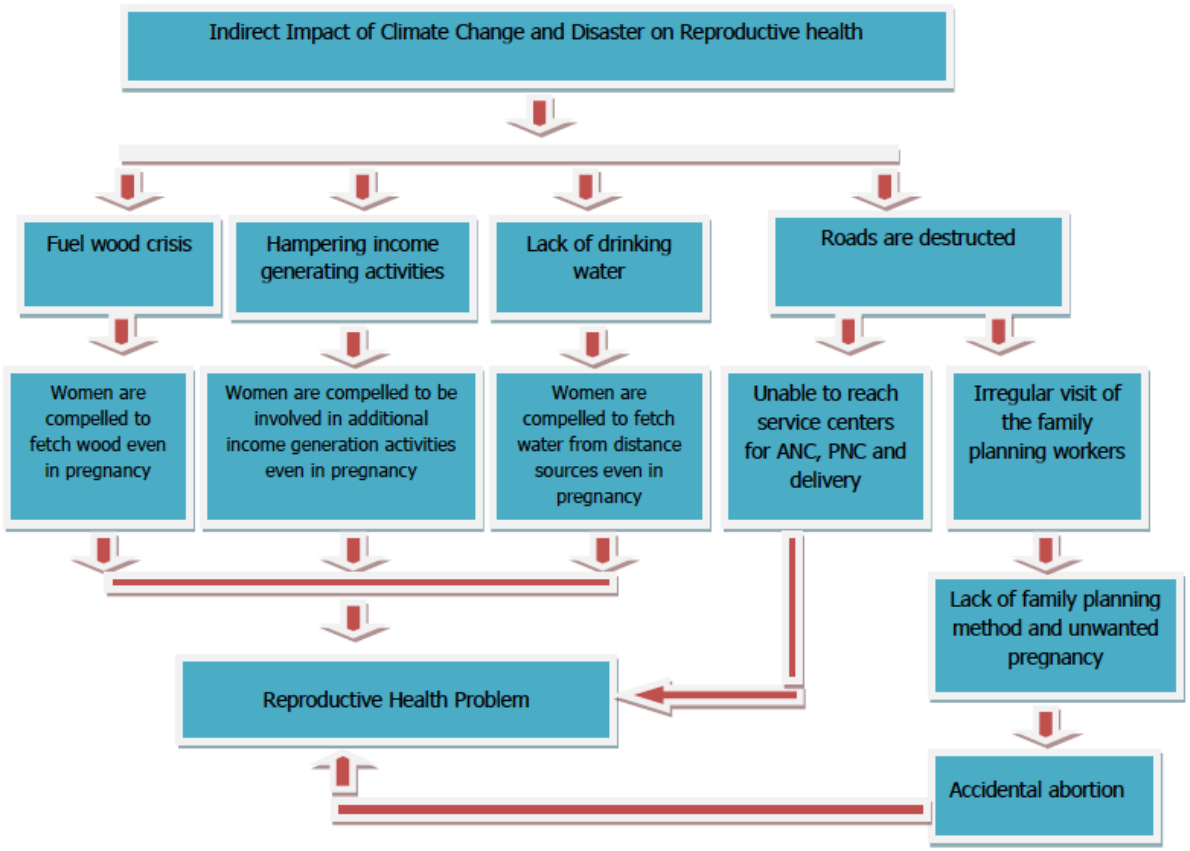

Figure 3.2 – Indirect impacts of climate change and disaster on reproductive health in vulnerable coastal areas of Bangladesh

The key relevant policy documents identified included:

- National Population Policy 2009
- Health, Population and Nutrition Sector Development Program (HPNSDP) 2011 – 2016
    - Program Implementation Plan
    - Strategic Implementation Plan
- Non-Communicable Diseases Control Operational Plan
    - Component Four: Climate Change, Air Pollution, Water Sanitation & Other Environmental Health issues
    - Component Five: Emergency preparedness and Response (EPR), Post Disaster Health, Management and Emergency Medical Services (EMS).
- National Maternal Health Strategy 2001
- National Adolescent Reproductive Health Strategy 2006
- National Communication Strategy for Family Planning and Reproductive Health 2008
- National Plan for Disaster Management (NPDM) 2010 – 2015
- National Environment Policy 1992
- Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2008
- National Adaptation Program of Action (NAPA) 2009
- Women Development Policy 2011
- Sixth Five Year Plan 2011 – 2015

Based on a transparent method of analysis of both policy standard and coverage of climate change and reproductive health linkage, none of the policies were found to effectively address the linkage between climate change and reproductive health. Though a series of recommendations for policy improvement were made, these were quite general with little detail as to what and how.

Urban settlements

Identified as an important, but under analysed issue for South Asia (eg World Bank, 2013) is that of urban poverty and climate change health vulnerability. Dhaka provides a useful case example. As a city, it is highly vulnerable to climate change, prone to flooding, has a high urban population density, substantial rates of urban poverty and a large percentage of population in informal settlements. It is estimated that in the period from 1996 to 2005, the total population in informal settlements in Dhaka more than doubled and at the same time in Dhaka, the proportion of urban poor increased from 20 to 37% of the total population (Jabeen and Johnson (2013). Their study of two informal settlements in Dhaka (Korail and Mohammadpur beribadh)identifies the types of climate impacts experienced by residents include heat, dengue fever, physical changes on livelihood and income, increased water-borne diseases, new diseases and some increases in respiratory diseases.

Household and community responses to climate impacts varied from increasing height of furniture and making higher storage facilities to moving family to safer areas and changing building materials and varied by previous exposure and experience of the impact and was different between the two communities, possibly relating to different land tenure and poverty levels. An important finding of the research was the important role in community and friends and social networks in adaptation.

Community coping strategies

An important reminder about existing resilience within the Bangladeshi community and the fact that climate variability is not a new health stressor can be drawn from the work of Haque et al (2012). A self-reported cross-sectional survey was conducted to investigate current 'adaptation' or coping strategies of individuals to climate related diseases in two Bangladesh districts of Khulna and Rajshahi. The study examined a range of climate parameters and identified numerous important issues, pertinent to this analysis of climate change and health adaptation in Bangladesh.

Firstly it identified that individuals already take action to 'cope' with illness and disease that are influenced by climate change. These actions were identified in three areas of heat sickness related, cold sickness related and sickness related to the rainy season. Of the 52 questions asked about coping strategies, 22 were practiced in these communities. Of the 11 heat related strategies the most popular included drinking more water (99.1%), finishing tasks early in the morning (93%) and drinking different homemade juices (96%). Of the 6 strategies employed in the rainy season, the most popular included using mosquito netting to avoid diseases (99%) and trying not to get wet in the rain (92%). Interestingly, and alarming from a public health perspective, there were comparatively lower positive responses for important strategies for avoiding water or vector-borne disease such as drinking boiled water (10%), avoid using water from river or pond (61%) and don't let water stand beside the house (47%).

These findings suggest that individuals and communities already consider the impact of climate parameters into their daily decision making if the effect of the climate parameter is direct – for example heat makes people thirsty. However, for less direct health issues like water contamination and vector habitat promotion, individuals were less likely to take action, suggesting health promotion efforts need to improve.

3.2.3 Climate change activity relevant to health adaptation

As identified by Haque et al (2012), there has been very little attention in the research community on heath vulnerability in the community to climate change and responses to it in the Bangladesh context.

However, there has been considerable investment by International and local NGOs into project-led activity in key areas relating to climate change and health, particularly in the areas of water and sanitation (eg BRAC, WaterAid, ActionAid), improved community resilience to disasters (eg.IFRCC) and community based approaches to adapting to climate change (eg. CARE, ActionAid). There is also much focussed effort (eg World Bank, BRAC, Grameen, Proshika) on poverty alleviation that will ultimately reduce population vulnerability and increase resilience to environmental changes). Despite the many and varied projects in Bangladesh that relate to climate change and health issues there is a lack of coordination and national learning from such projects, such that their role in informing long term policy and associated actions has been limited (BCAS, 2010). This represents a missed opportunity and it will be important moving into the future that a central agency or institution takes responsibility for coordination and synthesising the results of such projects in order to improve practice, both within and external to government.

Community Based Adaptation (CBA)

There have been numerous large scales CBA projects conducted in Bangladesh. Haque (2013) conducted a study in Khulna City in order to identify the importance of different types of adaptation options (structural, repair and maintenance, managerial, awareness) useful to respond to the water changes predicted for Khulna, for 4 categories of stakeholders with the purpose of better understanding how stakeholder based CBA might influence adaptation compared with traditional forms. The research indicated that when diverse stakeholders were engaged (4 groups examined: private households, communities, government, environment) outcomes are quite different with different views about scale of actions, timeframes for actions and types of actions.

THE RVCC Project by CARE (Bangladesh and Canada, 2006) was a large and pioneering CBA project that examined climate change adaptation from a vulnerability perspective rather than focussing on sectoral impacts. The project worked on four levels: household, community, institutional and national, and focussed on those priority areas identified that were directly linked to climate change – including salinity, waterlogging, flood and drought, and attempted to reduce the impacts of these issues on household wellbeing. The summary document provides a useful analysis of lessons learnt for projects of this type. Further analysis of CBA type projects for Bangladesh is provided by Rashid and Khan (2013).

A comprehension analysis provided in Part 4 – Adaptive actions in Shaw et al (2013), indicates the breadth of adaptation action in Bangladesh, detailing the many actions from an agricultural, livelihood, ecosystems, infrastructure and habitat perspective. While adaptation in other sectors such as agriculture may positively benefit health through providing increased food security it can also have negative consequences if providing equitable water access to all water users, including for drinking, sanitation and hygiene purposes, is not a strong principle of adaptation actions.

An analysis of CBA activity in Bangladesh suggests that the 6 common features of CBA include people centred, process dominated, community based/community led, knowledge oriented, empowerment focused and accountability driven (Rashid and Khan, 2013).

3.3 Key relevant policy and strategy in Bangladesh

The central strategy document providing direction on climate change adaptation in Bangladesh is the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) (2009), linked to the higher level NAPA policy (2005). The NAPA (2005) provides context to the climate change challenge in Bangladesh through identifying existing stresses and pressures, identifying existing and future impacts of climate change and identifying adaptation strategy projects. Being a policy document the adaptation measures it proposes are at a very high level though it recognises that adaptation needs to be integrated with existing activity and it does acknowledge the range of vulnerabilities, eg. regions, gender, socio-economic disadvantage that need to be considered.

From a health perspective, it contains limited analysis of health impacts, with scant attention paid to linkages between health outcomes and other impacts. This lack of health consideration is likely due to the lack of consultation with health agencies in its development as identified within the document. This is not unusual for a first iteration of national documents such as this, as climate change policy has historically been driven by the natural resource sector with agencies such as Environment, Meteorology, Agriculture and Water prominent in their development.

The BCCSAP (2009) provides a plan for action for 2009-2018. It identifies the need to link to sustainable development, poverty reduction agendas and consider vulnerability as a focus for assessment. The document outlines the key changes for Bangladesh in terms of climate change into the future, the key resulting impacts, key issues for adaptation and identifies six pillars for action: Food security, social protection and health, Comprehensive disaster management, Infrastructure (focus on physical), Research and knowledge management, Mitigation and low carbon development, Capacity building and institutional strengthening. The proposed implementation and institutional arrangements for the climate change action plan is shown in Figure 3.3

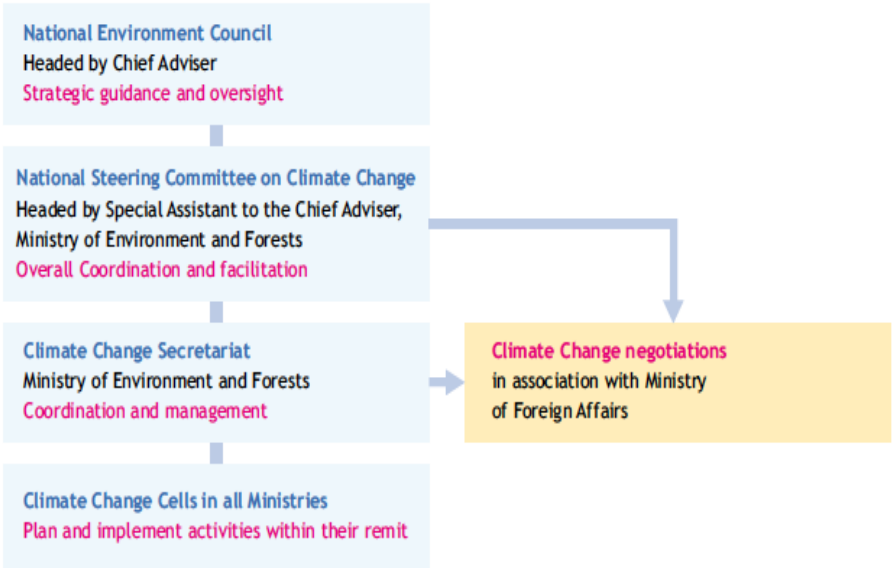

Figure 3.3 – Organisational chart for the BCCSAP

Across all 6 pillars the BCCSAP document identifies the need to consider needs of vulnerable populations and in comparison to the NAPA it identifies more health issues including the less direct ones associated with migration and urbanisation. The health priorities identified include vector-borne and water-borne diseases with some mention of extreme heat and it has limited explicit consideration of health services. Other identified deficits from a health perspective include lack of recognition of social and health infrastructure in the infrastructure pillar (which, as noted by the BCAS (2010) is heavily dominated by physical infrastructure) and a lack of targeted programs for some of the less direct health impacts related to migration and urbanisation.

The analysis by BCAS (2010) suggests that the BCCSAP has also failed to clearly identify stakeholder roles which are a significant issue for the health sector whose progress on health outcomes often requires strong collaboration with other key sectors. Without clear roles and responsibilities articulated for other agencies, health's advocacy and collaboration potential is challenged.

One of the other important criticisms of the BCCSAP strategy is that there is no priority given to which of the adaptation programmes should be actioned when and that adaptation programmes are not costed and hence funding options not identified (O'Donnell et al, 2013).

Other important policy and strategies relevant to climate change adaptation for health are classified into 3 levels – national, sectoral and program (refer to Figure 3.4). A number of other agency policies, protocols or processes may provide opportunity for climate change adaptation for health; however such an analysis would be the subject of a more extended project. For example, large scale public campaigns for raising community awareness about vector control and protection from vector-borne disease and water-borne disease and water quality might require improved engagement with

local government agencies or the Information Ministry. Consideration of vector habitat control might be needed to be included in environmental impact assessment legislation or vetting guidelines for construction projects, or agricultural or industrial guidelines. Furthermore the impacts of declining water quality and supply on livestock and associated impacts of food security and livelihood may also require additional focus.

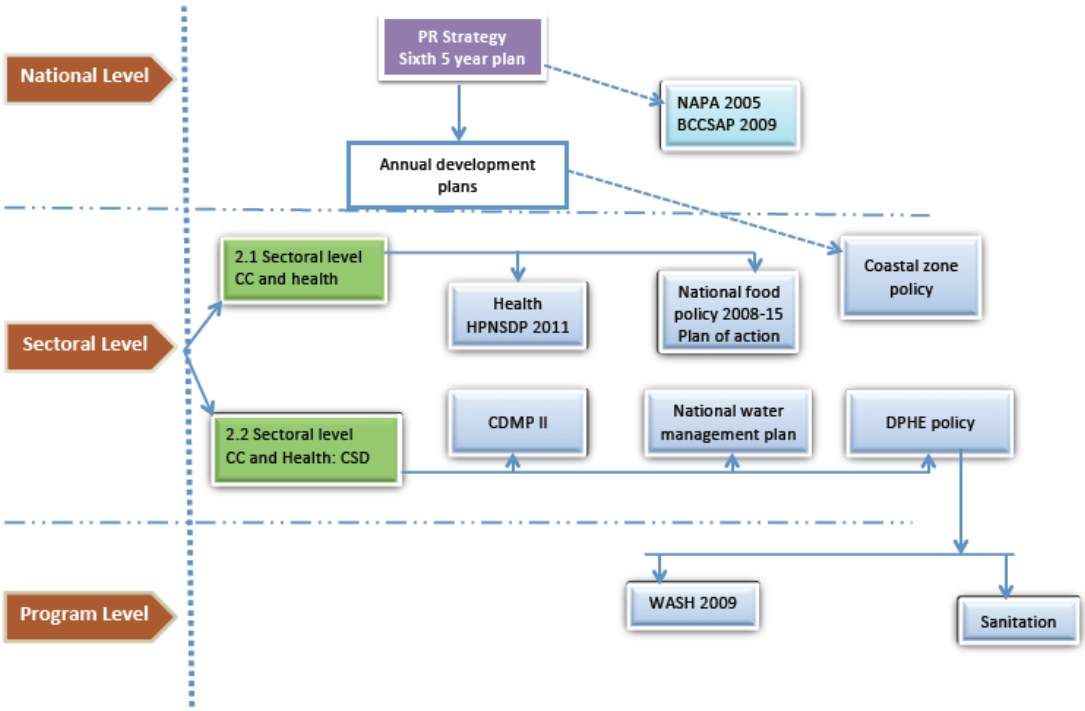

Figure 3.4 – National, sectoral and program level policy/strategy potentially relating to WASH and climate change in Bangladesh

3.3.1 National level –setting policy directions for the country as a whole

The Sixth 5-Year Plan FY2011-2015, National Development Planning and Poverty Reduction Strategy is the key strategic planning document for Bangladesh. Though this document is not specific to climate change its focus is on poverty alleviation, a goal that will also reduce overall population vulnerability to climate change. Particular chapters of relevance to climate change specifically include: Chapter 6 – Poverty Inclusion and social protection, and Chapter 8 Environment, Climate Change and Disaster Management for Sustainable Development.

The poverty chapter identifies regional inequities, linking water to poverty and key strategies to address these. This is important given that water issues will be a high priority for Bangladesh in a climate changing environment. It describes the 4 key areas for focus for the way ahead as:

- Strengthening the public service
- Strengthening local government
- Public-private partnerships
- Improving the planning and budgetary processes

All focus areas can have benefits for climate change adaptation, particularly the strengthening of local government, given that climate change adaptation will be most effective if health risk issues and adaptation responses are identified and developed at a local level to reflect the diversity of vulnerabilities at a local level.

The document does make some cross-references to other policies, eg Food issues are cross referenced to the National Food Policy 2008-2015. Chapter 8 on the Environment, Climate change and Disaster Management for Sustained Development, identifies the adaptation needs across program areas from the BCCSAP. It identifies benchmarks for climate change adaptation across program areas and includes numerous links to health and some for water specifically but limited progress and experience has been identified.

From a water perspective, the 5year plan acknowledges the importance of water supply to development and points out the strong links between poverty and the availability of safe water and sanitation. 11 strategies are identified in this section aimed to increase water sanitation and supply. However, the question remains – what is the progress against these strategies?

Despite the Poverty Reduction Strategy document calling for climate change mainstreaming, it doesn't identify the means for integrating adaptation into other sectors or identifying priority target sectors. Furthermore it limits mention of climate change to the environment chapters hence presenting climate change as an 'add-on' rather than an integral determining factor in poverty alleviation efforts (Tanner et al 2007).

3.3.2 Sectoral polices/plans that have links to climate change

Health

The National Health Policy (2011) makes no specific mention of climate change, but does have a specific policy strategy of 'Health for All' that encompasses both health promotion and disease prevention. The Health, Population and Nutrition Sector Development Plan (HPNSDP) 2011-2016 and associated Program Implementation Plan, provides a very comprehensive analysis of key health issues, a detailed strategy for each of the operational plans along with detailed budgeting details. The HPNSDP recognises climate change as a large challenge and identifies it as a cross-cutting issue. It is included in its own Section 3.3.5 Environmental Health and Climate Change, which is focused on emergency preparedness and response as well as mitigation and adaptation related to the longer-term health effects of climate change. It is included in the Non-Communicable Diseases area within the DGHS and included in the NCD Operational Plan. While the establishment of a Climate Change and Health Unit within the Ministry of HFW, its location within the NCD Operational Plan has the potential to limit its reach and ability to influence other aspects of health that are linked to climate change.

Food

The National Food Policy (2006) and associated National Food Policy Plan of Action (2008-2015) have the goal of ensuring a dependable food security system for all people of Bangladesh at all times. The policy makes strong links to health, but the National Food Policy and Plan of Action only make a

cursory assessment of climate change as a threat to food security. The Plan of Action does make a link between food security and water, through a particular area of intervention -3.5: Safe Drinking Water and Improved Sanitation. Furthermore, it acknowledges 'there is a lack of coordination between the two pillars of nutrition, namely the Ministry of Health and Family Welfare (supplementation, fortification and disease control-based actions) and the Ministry of Agriculture 'food-based actions' (pg 49).

Water

The National Water Policy (1999) lays down the principles of development of water resources and their rational utilisation under varying constraints, including a specific section on Water supply and sanitation. There is no mention of climate change in this high-level policy document and this possibly reflects its age. The associated 2001 National Water Management Plan (in 4 Volumes) operationalizes the goals identified in the National Policy and assesses water issues in 8-sub-sectoral clusters over 8 planning regions. This Management Plan is very comprehensive and well structured. It assesses risks, assumptions, identified parallel and program linkages and links to National Development Policy and Programs. It assesses the breadth of agencies involved in water management within and outside of government and clearly identifies the programs for each of the 8 sub-sectoral programs with associated agency responsibilities and inputs. It also identifies other related policy.

It also explicitly acknowledges that climate change is an exacerbator of many issues, for example in agriculture, and climate change is identified under the knowledge gap section (in terms of understanding impacts and responses. However it does not provide any insight into how to address climate change or identify specific adaptation measures. The Climate change and health cell of MOHFW is identified with some responsibilities in the major cities cluster. Importantly, the 2nd of 3 objectives of the water management plan identifies the importance of water for health protection: Objective 2 'Quality of life improved by equitable, safe and reliable access to water for production, health and hygiene'.

One entire volume examines water sources, demands and external pressures on a region by region basis. These regional plans provide an excellent opportunity for health engagement given the differential vulnerabilities in the country, often driven by water issues.

Disaster management

Comprehensive Disaster Management Program (CDMP)

The Bangladesh Government approved the Comprehensive Disaster Management Program (CDMP) in 2003 as a key strategy to reduce the disaster risk of the country. CDMP was considered as a strategic institutional and programmatic approach for optimizing the long term risk and to strengthen the operational capacities during emergencies and disasters and also to improve the recovery from those disasters. CDMP was adopted with a vision to "reduce the vulnerability of the poor to the effects of natural, environmental and human induced hazards to a manageable and acceptable humanitarian level".

The mandate for driving this program was given to the Ministry of Food and Disaster Management (MoFDM) which in 2012 separated into two different agencies. The program's mission is "To achieve a paradigm shift in disaster management from conventional response and relief to a more comprehensive risk reduction culture". However, a "Policy, Program and Partnership Development Unit (PPPDU) had been established to operationalize the CDMP process and to serve as a national focal point for the coordination of disaster management activities.

There were several key global and national drivers that influenced the formulation of the strategies of CDMP. They include the Millennium Development Goals (MDGs), International Strategy for Disaster Reduction (ISDR) – National Platforms, World Summit for Sustainable Development (WSSD), World Conference on Disaster Reduction (WCDR), Interim Poverty Reduction Strategy Paper (I-PRSP), Poverty Reduction Strategy Paper (PRSP), Common Country Assessment (CCA), and United Nations Development Assistance Framework (UNDAF).

CDMP strategies have been developed for the whole country though the communities who were identified as highest risk were prioritized for immediate benefits. The CDMP seeks to reduce the level of community vulnerability and enhance sustainable development initiatives through a range of integrated strategies containing five strategic focus areas: Professionalizing the Disaster Management System, Partnership Development, Community Empowerment, Expanding Mitigation, Preparedness and Response across a Broader Range of Hazards, Strengthening Emergency Response Systems) and ten components including Climate Change and Research.

Key benefits of the CDMP approach are the best use of resources and expertise of different agencies according to national priorities, a mechanism for identifying the gaps, provision of the basis for formal partnerships, validating new projects according to country needs and serving as a management tool for donor agencies. The National Plan for Disaster Management for 2010-2015 is a key document of the Government of Bangladesh. The plan considers the basic principles of the SAARC Framework on Disaster Management and through its comprehensive Disaster Management Program it has more effectively mainstreamed disaster management in development plans and programs. The Cyclone Preparedness Program activities and disaster management program activities are highly praised by the world community and perceived as pioneering.

The key focus of the National Plan for Disaster Management is to establish institutional accountability in preparing and implementing disaster management plans at different levels of the country. The use of plans that incorporate Disaster Risk Reduction and Hazard Specific Multi-Sectoral Plans have made this plan an important tool for reducing risk and achieving sustainable development.

This disaster management document has included both natural and human induced hazards in its action plan, involving government and nongovernment organizations, and the private sector in a comprehensive way. The plan was prepared in a participatory manner, including numerous consultations with stakeholders and established a road map of partnership at local, regional and national levels with an expectation that the plan will contribute towards developing and strengthening regional and national networks.

This plan covers the natural hazards and disasters that commonly occur in Bangladesh and clearly mentions that climate change is happening and it likely impacts on disasters in Bangladesh. It also identifies the important linkage between disaster and development. It identifies the links with Millennium Development Goals, the Poverty Reduction Strategy Paper (PRSP), Recommendations of the National Workshop on Options for Flood Risks and Damage Reduction in Bangladesh, 2004, Hyogo Framework for Action (HFA) 2005-2015, United Nations Framework Convention on Climate Change (UNFCCC), SAARC Framework for Action (SFA) 2006-2015 and Bangladesh Climate Change Strategy and Action Plan 2009.

Like other plans, this plan has a strategic goal, distinct objectives, a regulatory framework and outlines the ways in which plans are integrated at different levels. The plan identifies the disaster management model for Bangladesh, mainstreaming risk reduction strategies and disaster management institutions at different levels in Bangladesh.

Coastal Zone

The 2005 National Coastal Zone Policy is unique in that its purpose is to harmonise policy that transcends sectoral perspectives by initiating a process that commits different Ministries, Departments and Agencies to agree and to harmonize and coordinate their activities in the coastal zone. Its stated purpose is 'to give general guidance so that the coastal people can pursue their livelihoods under secured conditions in a sustainable manner without impairing the integrity of the natural environment' p3. It recognises key principles of: vulnerability, inequality, sustainable management, empowerment of women's development and gender equity, conservation and enhance of critical ecosystems. It describes the need for a supportive institutional environment and describes issues around implementation, mainstreaming, strategic planning, coordination and supporting activities. It acknowledges the health of coastal communities as an important issue.

Given that coastal populations are particularly vulnerable to climate change in Bangladesh, this high level policy document provides a potential avenue for health engagement through its recognition of development of an appropriate institutional framework.

3.3.3 Program level - WASH

Safe water and sanitation are essential for public health security. Activity in the WASH sector is underpinned by the 1998 National Policy for Safe Water Supply and Sanitation. The broad goal of the policy is to ensure that all people have access to safe water and sanitation services at an affordable cost and that development in the water supply and sanitation sector is equitable and sustainable. It provides a series of objectives and sets targets and identifies principles for strategy development.

Water Supply

The National Sector Development Programme for Water Supply and Sanitation, 2005 (NSDP 2005) was developed by the Ministry of Local Government, Rural Development and Cooperatives (MLGRDC). The document provides a very useful overview of water issues for Bangladesh and in a clear and concise manner identifies the key challenges associated with the drought and flood cycle, increasing rate of urbanization, the limited piped water supply in many cities and towns, inadequate

and inappropriate urban sanitation, inefficient operation and maintenance, arsenic contamination, lowering of groundwater tables and gaps in services for very remote areas, hygiene behaviour in the community, improved latrine design and use, environmental and climate changes and inadequate research and development. It also provides a useful discussion of the opportunities which range from improved linkages with high level policy (like through the Sixth 5-Year Development Plan) and high political commitment to successful community based approaches. Importantly it introduces new concepts such as Water Safety Plans and a Sector Wide Approach (SWAp) which have the potential to be important mechanisms for mainstreaming climate change adaptation. It also includes as one of its series of action points for implementation, a specific action area to 'Safeguard Environment, Tackle Climate Change and Manage Disasters'.

National Sanitation Strategy 2005

The National Sanitation Strategy was adopted in early 2005 under the responsibility of the Local Government division of the MLGRDC. It provides an overview of the relevant polices, guiding principles and success stories and lessons learned from specific sanitation activities in the community as well as specific actions.

This strategy recognizes that Bangladesh is committed to achieving the sanitation related MDGs, linking them to the high-level Poverty Reduction Strategy. The importance of the impact of low coverage of sanitation and linkages between poverty and sanitation is identified in the strategic document. The National sanitation strategy also explores the linkage with other policies, including "National safe water supply and sanitation 1998" and the National Water Management Plan 2004.

The document includes six major focus areas: open defecation, the lack of coverage in the extremely poor populations, use of unhygienic latrines, lack of hygiene practice, urban sanitation, solid waste and household waste water disposal. It identifies some of the key strategies for improving sanitation including: Creating effective demand through health education and hygiene promotion, ensuring individual and community actions, activating local government initiatives, facilitating adequate supply chain of hygienic latrines, reaching the hard core poor, improved urban sanitation, media campaigns, sustainability, particular focus on stakeholder involvement, financing of sanitation program, monitoring and evaluation strategy and strategies for emergency response.

Water policy

Water issues are consistently identified as a significant climate change impact for Bangladesh. Water supply is challenged in some parts of the country where droughts are more common and in dry seasons due to limited storage and water contamination of natural water sources. Flooding is associated with elevated drowning risks, increased skin contact with contaminated water and seasonal water quality issues due to disruption to normal supplies and contamination of surface water supplies. Water-logging can impact on skin diseases. Cyclones and associated storm surges disrupt access to supplies and damage infrastructure and also affect water quality. Sea level rise and subsequent salinity presents significant challenges for water quality and water availability for food

production and in the long term may be responsible for food shortages and population displacement.

Despite the necessary focus on water supply and sanitation in rural areas, climate change and other pressures related to population increases related to industry, agriculture and household use are projected to place increasing pressures on water supply in urban areas. Groundwater management will become an increasingly important issue as recharge processes are altered by climate change and climate change adaptation practices and water demands grow, particularly in urban areas. As identified by NSDPWSS (2011) the lowering of groundwater due to over-abstraction in and around Dhaka city is a specific problem.

For all these reasons, climate change impacts on water supply and quality remains a significant issue for Bangladesh's continued development and climate change (GoB, 2013). Achieving equity in water management will be a key challenge for policy makers into the future as pressures on water supply and quality increase due to climate change and Rasul and Chowdhury (2010) propose a framework for this that includes prioritizing public health security as a key platform. The National Water Policy (2000) explicitly states as its goal, 'to ensure progress towards fulfilling national goals of economic development, poverty alleviation, food security, public health and safety, a decent standard of living for the people and protection of the natural environment.' Furthermore the NWMP (2004) includes in one of its objectives 'equitable access to water for health and hygiene ' and it includes a multi-use approach to water and an emphasis of 'soft' approaches to water management, including better management of water resources, instead of just promoting engineering approaches (Rasul and Chowdhury, 2010).

The overarching water policy is complemented by program-level plans relating to water quality, sanitation and hygiene which are overseen by the Department of Health and Engineering, within the Ministry of Local Government and Rural Development and Corporations. These plans are focussed on delivering adequate water quality and supply at the community level acknowledging the need for both soft and hard infrastructure. They represent an important opportunity to build in climate change resilience into water supply and sanitation systems. Furthermore, vetting guidelines for WASH projects have been developed by the MLGRD so that future projects consider climate change adaptation in their design and implementation.

The WASH sector in Bangladesh has made significant progress in meeting MDGs and appears to have an active policy development process. For example, in the past five years it has developed a raft of policies and strategies including:

- National Hygiene Promotion Strategy for Water Supply and Sanitation in Bangladesh, 2012;

- National Management Information System (NaMIS) for Water Supply and Sanitation Sector, 2011;

- National Ground Water Database for Water Supply and Sanitation Sector, 2011;

- National Cost-sharing Strategy for Water Supply and Sanitation Sector in Bangladesh, 2011;

- National Strategy for Water Supply and sanitation Sector for Hard-to-Reach Areas in Bangladesh, 2011;

- Water Safety Framework (WSF) in Bangladesh, 2011;

(Source: http://www.psu-wss.org/achievements.html)

However, as water demands grow due to population, agricultural and industrial development and water supply alters as a result of climate change, water supply and sanitation professionals will need to more fully engage within an integrated Water Management system – a practice that is still far from optimal in many areas of the world (WHO-DFID, 2013).

3.4 Existing institutional arrangements for climate change

There are numerous agencies involved in climate change adaptation in Bangladesh. Figure 3.5 shows their relationships and their influence on climate change adaptation in the Bangladesh context. A list of the key agencies and their roles is provided in Box 3.1.

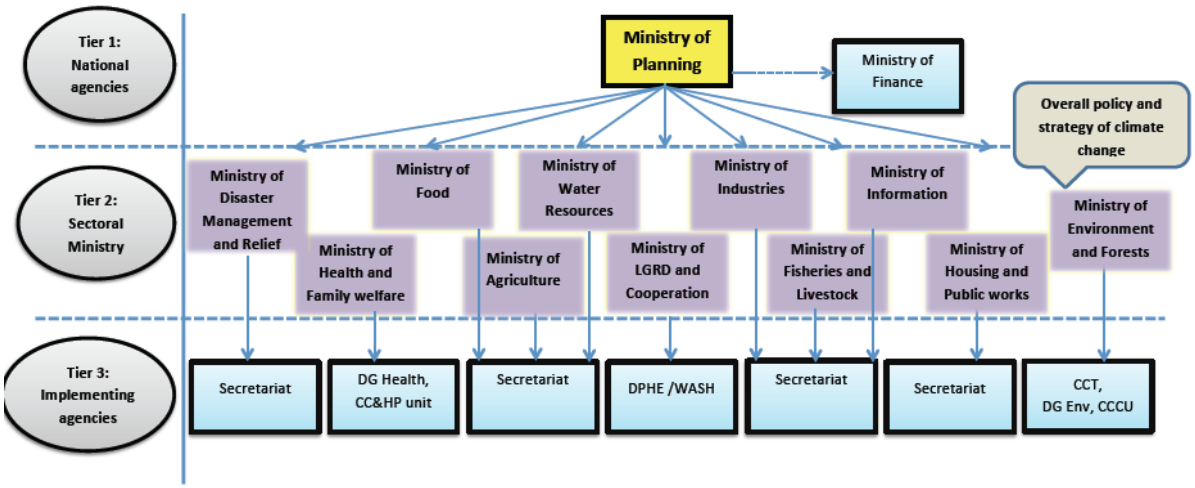

Figure 3.5 – Agencies related to climate change adaptation with a particular focus on water and health

Box 3.1 – Government agencies and sectors contributing to climate change adaptation in Bangladesh (BCAS, 2010)

The **Ministry of Environment and Forests** is the Climate Change Focal Point and responsible to comply under the decisions of the UNFCCC and KP. They are responsible for the preparation of national communication, formulation of national adaptation program of action, providing approval for CDM projects, attending international negotiations and facilitating mainstreaming at the sectoral level.

The **Ministry of Planning** is responsible for facilitating overall midterm and perspective planning. It also supports sectoral planning and provides guidance. The General Economic Division of the Planning Commission has initiated a process to enhance institutional capacity of the GED to facilitate climate change in the planning perspective.

The Ministry of Finance is responsible for Budget allocation. The government has allocated resources to deal with adverse impacts of climate change from national budget.

Ministry of Health/DG-Health is responsible for countrywide diseases surveillance, ensuring adequate availability of health services, for example, Ambulance, Medicine, Vaccine, Surgical Equipment etc. in the Thana Health Centers of disaster prone areas.; educating people about health care through radio, television, newspaper and other media during floods and after cyclones; establish temporary hospitals and cyclone shelters to meet the emergency needs and ensure active participation in the meeting of Inter-Ministerial Disaster Management.

The Bangladesh Meteorological Department (BMD) is responsible for watching over weather conditions, and ensures improvement of cyclone forecast procedures and supply of information on regular basis. They ensure full time effectiveness of the quickest channel of communication for disseminating weather warnings to all concerned. Fax arrangement must be established between SWC of Meteorological Department and Radio, Television and the Ministry of Food and Disaster. Prepare and submit Special Weather Bulletin and broadcast/publicize the same through national news media such as the all stations of Radio and Television and in national newspapers for the benefit of the general people.

The objective of the **Food Ministry** is to supply food stuff and essential commodities to the consumers, to build up emergency stocks, to attain self-sufficiency in producing food grains, to expand social safety net, to maintain the price of food grain stable, to introduce effective and reliable food grain procurement, supply and distribution management, to achieve farmer and consumer friendly food grain pricing, to introduce effective and updated food distribution system, Introducing fruitful food management system to face drought, famine and food crisis, to help the poor and socially deprived people collect their food, to adjust food Safety Policy with disaster management/relief distribution system, to supply food grains to the target oriented people, to make professionalism able and efficient work force.

The vision of the **Ministry of Disaster Management and Relief** is to reduce the risk of people, especially the poor and the disadvantaged, from the effects of natural, environment and human induced hazards to a manageable and acceptable humanitarian level and to have in place an efficient emergency response management system.

Ministry of Water Resources/Bangladesh Water Development Board: The Flood Forecasting and Warning Centre (FFWC) of Bangladesh Water Development Board will act as Focal Point and the Deputy Director in Charge of the Centre will act as Liaison Officer. They are responsible for the construct of embankments in disaster prone coasts and islands according to designs approved by the government; undertake operation of sluice gates and other water discharging devices in completed embankment areas; monitor continuously the condition of the embankment and repair the breaches and weak points in adequate manner and operate the Flood Forecasting and Warning.

Ministry of Agriculture, Bangladesh Rice Research Institute (BRRI), Bangladesh Agricultural Research Council (BARC) and Bangladesh Agricultural Research Institute (BARI) are responsible for carrying out research on the development of different crop varieties resilient to different climate stresses. They are to arrange for keeping stocks of seeds, fertilizers and insecticides; training of various levels of officers for participation in different steps of cyclone preparedness activities; allocation of funds for the purchase and distribution of seeds and fertilizers; and the implementation of post disaster relief operations.

Ministry of Information is responsible for the popularization of the techniques for preparedness and survival during pre-disaster, disaster and post-disaster period including leaflets/booklets supplied by the Disaster Management Bureau and concerned Ministry through television, Radio and other publicity media. They are to arrange wide publicity with the help of mass media about the cyclone and flood warning signals with necessary explanations; ensure strict performance of the allotted duties by Radio, Bangladesh Television, News Media, Press Information Department, Mass Communication Department and Films and Publications Department/normal times and specially during cautionary / warning and disaster stages.

Ministry of Local Government, Rural Development and Cooperatives, and its associated organizations are responsible to encourage local government agencies for building roads, bridges and culverts for communication to cyclone shelters and growth centers; advise people to keep the foundations of their residence above flood level; prepare maps showing population concentration and deep wells, protected pond and other sources of drinking water; ensure reserve stock of

tube wells and spare parts; ensure availability of drinking water at times of need; direct local government institutions for extending assistance to the Deputy Commissioner and the Thana Executive Officer for rescue and relief operations; ensure availability of repair workers for emergency repair of damaged tube wells in affected areas and send technicians from unaffected areas to the affected areas.

The **CCC unit (CCCU)** within the Ministry of Environment and Forestry is the agency responsible for climate change policy in Bangladesh. It is tasked with mainstreaming climate change into national development planning as well as coordinating and building capacity within the climate change focal points in the key identified ministries. According to analysis by O'Donnell et al (2013), the performance of the CCCU appears to be limited for many reasons, including a weak structure, duality in mandate, lack of manpower and trained human resources and weak legal framework. They argue that MoEF does not yet have a clear legal mandate, nor have the necessary established frameworks to lead all the activities centred on climate change in Bangladesh.

The **Bangladesh Climate Change Trust (BCCT)** is an independent body responsible for administering the Bangladesh Climate Change Trust Fund which is a specific fund set up to address the climate change adverse impacts in Bangladesh. The objective of the BCCTF is to develop adaptive capacity for the vulnerable communities who are exposed to climate change adverse impacts by improving their livelihoods and minimizing the risks; to address climate change adaptation and mitigation through technology and transfer, financing to building capacities to reduce its impact on people, biodiversity and environment and to respond inpost disaster management relating to climate change.

Its stated aim is to support the implementation of the Bangladesh Climate Change Strategy and Action Plan (2009) with a legal mandate by the Climate Change Trust Act 2010. It is run by an independent board of trustees, chaired by the Minister of Environment and Forests. The board of trustees consists of 17 members including 10 minsters from different ministries, including health, food, water, disaster, land, finance.

The CCT has a 13 member technical committee, who are the responsible for review and selection of specific projects for implementation. Though it has a stated role for monitoring the approved projects, its capacity to effectively undertake this role is limited. Furthermore, despite its stated aim of supporting implementation of the BCCSAP, undertaking this broader role of overviewing the implementation of all actions in the BCCSAP (2009) appears to be far beyond its current capacity. How it liaises and coordinates activities with other key climate change units across government and external to government is not clear.

The **Climate Change and Health Promotion unit (CCPHU) within** MoHFW is responsible for administering the identified climate change related actions of the HPNSDP. Its stated goal is to '*build capacity and strengthen health systems to combat the health impact of climate change and to protect human health from current and projected risks due to climate change*'. Its stated objectives are:

- To coordinate all Health Promotional activities of Intra and Inter Ministerial initiatives.
- To increase awareness of health consequences of climate change;
- To strengthen the capacity of health systems to provide protection from climate-related risks through e-Health and Telemedicine;
- To ensure that health concerns are addressed in decisions to reduce risks from climate change in other key sectors;
- To conduct research, evaluate and monitor programmes related to health promotion and climate change;
- To coordinate emergency medical services and school health promotion to reduce health hazards during disasters and emergencies.

(http://cchpu-mohfw.gov.bd)

One of its identified current projects is titled "Risk reduction and adaptive measures in the context of climate change impact on health sector in Bangladesh". It has a very broad scope - *To conduct research and monitor disease patterns and develop effective adaptive measures in the context of climate change impact on health* and a comprehensive list of objectives however no specific project details, progress or outcomes for any of the objectives has been provided on its website.

3.5 Analysis of gaps and opportunities

3.5.1 Lack of a clear and comprehensive research agenda

The analysis by BCAS (2010) indicates that much of the research related to climate change adaptation in Bangladesh is scattered and piecemeal, conducted by a few research institutes and university departments, making it difficult to effectively inform national projects and policy. Furthermore it indicates that despite many small projects conducted by NGOs, they are not designed, implemented or evaluated within a research context, creating a missed opportunity for rigour and dissemination to the wider community.

The BCAS (2010) calls for a strategic national research agenda identifying a comprehensive list of research priorities, many of which relate to health or require health involvement. The WHO (2009) global review of health research needs in the area of climate change adaptation (refer to Section 1.3) also provides useful research direction for climate change adaptation for health.

3.5.2 Inadequate comprehensive recognition of climate change adaptation and integration of issues and actions across key climate sensitive portfolios

Both the BCAS analysis (2010) and the Tanner et al. (2007) review of existing key national Bangladesh policies suggest that that climate change issues are neither assessed nor tackled in a strategic manner. Despite the age of these policy assessments, few government policies have been reviewed since this time and this assessment is still likely to be accurate.

Furthermore, even when climate change adaptation actions and arrangements are in place, synergies between plans and programmes need to be strengthened (Pervin, 2013) and coordination from a policy, technical and economic perspective needs to improve (O'Donnell et al, 2013).

Part of the failure to better incorporate climate change into key policy documents and cross reference them to key national documents like the BCCSAP is the age of key existing policies and strategies. Many are from the late 1990s and early to mid 2000s, developed either prior to the development of the NAPA and BCCSAP or at around the same time. Furthermore, some of these older policies (eg. Forests (1994), Water (1999), and Land Use (2001)) have policy goals that conflict with climate change goals and need to be reviewed. The age of many key sectoral policies is attributed to the long review process (Pervin 2013), hence identifying the key sectoral areas for urgent policy review will be important to achieve the climate change adaptation goals for Bangladesh.

Other reasons cited by Tanner et al (2007) for the gap in climate change consideration in national strategy include low levels of scientific capacity and awareness about climate change processes and impacts in Bangladesh, international focus on mitigation rather than adaptation, its treatment as a predominantly environmental issue and the long timescales used in the analysis of impacts.

One notable exception of climate change consideration in key national strategic documents is the National Water Management Plan that explicitly indicates climate change issues as a knowledge gap. Also important for health, is that the second of the Plan's overall objectives makes specific reference to access to water for health and hygiene.

Linkage with the active disaster risk management agenda is also a positive for Bangladesh as disaster management has a long history in Bangladesh, has a focus on development and has assisted in establishing local planning processes and policy transformations that build climate resilience (BCAS, 2010).

3.5.3 Limited vertical integration and coordination

The critical role of local government is identified as one of the 4 focus areas in the Sixth 5-Year Plan. However, it is acknowledged that there is insufficient capacity of local bodies to plan and manage climate related projects and this has impeded improvements in climate vulnerability reduction (O'Donnell et al, 2013). In addition to this, the coordination between national, regional and local government remains limited, threating to undermine the effectiveness of the results of climate change adaptation projects and programs.

3.5.4 Need for clear and authoritative leadership

As identified by O'Donnell et al (2013), the MoEF is the current lead agency for climate change in Bangladesh. This situation is consistent with many other countries and partly reflects the historical focus on the physical changes in the environment that climate influences. However, as identified by

Jones et al (2007), ministries of Environment often tend to have limited power and resources within government decision-making, making it difficult to coordinate the activities of other, more powerful portfolios. Hence, in a developing country context, where climate change adaptation is linked closely to development, agencies responsible for advancing the development agenda through poverty reduction strategies and development planning are in a better position to integrate climate change adaptation into such high level polices and require sectoral agencies to consider climate change adaptation into their policy, implementation and monitoring frameworks.

The BCCSAP does not clearly articulate the roles and responsibilities of agencies and this has been a major criticism (BCAS, 2010).

The success of disaster management policy in Bangladesh may be partly attributed to the fact that disaster risk reduction is the domain of disaster management agencies, which commonly have more power than environment agencies. From a climate change perspective of course, they are limited in their scope and do not have a long-term adaptation focus (Jones et al, 2010).

From a health perspective, the leadership for health issues and definition of which health issues are a priority must also be clearly articulated. For example while climate change is considered quite well from a disaster management context, there remains uncertainty about who is responsible for water supplies and quality, food supplies and quality, nor issues relating to population movement and urbanisation (BCAS, 2010). Such issues also have significant linkages with health and hence how such issues are responded to in a climate change context must be determined such that there is a strong health voice when representing the needs of the 'health sector'. What constitutes the 'health sector', particularly in the context of climate change, needs to be defined.

3.5.5 Ineffective strategy implementation

The 2010 analysis by the BCAS indicates that at the time of writing, implementation of actions identified in the national strategic document remained a major challenge. This is further confirmed by the Pervin (2013) assessment of mainstreaming climate change resilience into development planning in Bangladesh, that suggests that despite the incorporation of climate change into various plans and projects (for example the Perspective Plan, the Sixth 5 year plan and the Annual Development Plans), there is no common framework for monitoring and evaluation of climate change adaptation or mitigation activities. It does indicate that the General Economics Division of the Ministry of Planning is developing such a framework and this is a positive step for driving climate change adaptation action.

The lack of a monitoring and evaluation framework for the BCCSAP makes it difficult to assess the implementation of the BCCSAP and reduces incentives for agencies to commit to climate change adaptation actions. From a health perspective, some limited climate change actions are included in the HPNSDP but progress on their implementation has not been publicly documented.

While the Climate Change Trust oversees the implementation and monitoring and evaluation of its trust funded climate change projects, it does not appear to be responsible for monitoring and evaluation of other climate change adaptation activities. However, one way forward may be to extend its monitoring and evaluation framework to other activities identified through the BCCSAP

and other national climate change actions, but of course this would require additional resources and capacity strengthening.

3.5.6 Identifying mainstreaming opportunities

Some steps are being taken to integrate climate change considerations into sectoral assessment processes and project implementation through the leadership of the CCC unit in the MoEF. For example, using material generated by the RVCC project (Tanner et al, 2007), guidelines have been developed by the CCC for the Community Risk Assessment process developed under the CDMP with the aim of developing uniform methodology for all vulnerable areas and to complete resulting bottom up climate change risk reduction plans.

As also indicated by a senior CCC unit staff (personal Communication, Oct 2013), all sectoral projects to be submitted and assessed for inclusion in the Annual Development Plan must have climate change considerations included, and the CCC Unit is working with sectors to develop internal guidelines to assist them in this process.

Other sectors, such as WASH, have been proactive through incorporating climate change issues into their vetting guidelines for infrastructure projects (2009).

There are many opportunities to integrate climate change adaptation into existing policy and planning processes. These opportunities are identified in key guidance documents described in Section 2. The key will be to develop mechanisms that encourage or require sectors to consider their own policies and processes, share their ideas and report on achievements, while in parallel providing resources for the key integrating/leadership agency to coordinate and report on sectoral changes and to encourage agencies to share their experiences, identified opportunities and successes. This will require strong leadership and whole of government cooperation and capacity building of relevant staff.

3.6 Section Summary

Bangladesh is identified as one of the most vulnerable climate change impact regions in the world and many of its vulnerabilities relate to water. Despite some useful health assessments, specific research on a diversity of climate change and health topics and much NGO activity in diverse areas related to reducing climate change vulnerability such as poverty alleviation, disaster risk reduction, and WASH, there remains a lack of national research focus on climate change and health impacts and adaptation.

Despite the establishment of a high level policy and associated action plan (NAPA and BCCSAP) and the explicit consideration of climate change into parts of the influential National Poverty Reduction Strategy, the long time frames associated with sector specific policy reviews has limited the inclusion of climate change into many sectoral policies and action plans. In addition there is no monitoring and evaluation framework for the actions identified in the BCCSAP which limits an analysis of progress against the policy and plan and may be responsible for limited activity and urgency given to many of the actions identified. The CCC unit provides the coordination and focal point for Climate

Change action within the Bangladesh government by linking to climate change focal points in each agency. However its effectiveness appears to be limited by the lack of a monitoring and evaluation framework, lack of a clear mandate and limited resources and staff capacity.

The MoHFW has clearly identified climate change as an issue in the HSPNIP and through its establishment of the CC and HP Unit within the NCD program it has taken an important step in recognising the health impacts of climate change and the need for appropriate adaptation. However the progress made by this unit is difficult to establish due to the lack of reported progress against its objectives.

Consideration of links to health and potential exacerbation of health issues by climate change has been established through the high-level water policy. This is a very positive step, complemented by much active policy development in the WASH sector which is administered through the MoLGRDC. The WASH sector has developed guidance on mainstreaming of climate change adaptation into existing decision-making processes providing a good starting point on which to identify other opportunities.

SECTION 4 – OPPORTUNITIES FOR THE HEALTH SECTOR IN BANGLADESH

4.1 Introduction

A small number of studies have been conducted on the health impacts of climate change in Bangladesh. They indicate the importance of water-borne and vector-borne health impacts and the potential health burden associated with extreme events. Some have explored health issues and climate change adaptation for particular vulnerable populations such as urban slum dwellers and others have analysed the direct and indirect reproductive health impacts of climate change.

There has been limited comprehensive and strategic assessment of climate change adaptation for health in Bangladesh, however much can be learnt from the international guidance and experience and general assessment of climate change adaptation in Bangladesh.

There are many challenges in the development of climate change and health adaptation strategy. The multi-determinants of health lead to complexity in analysing and understanding health impact pathways and challenges strategic development of prioritization of health action. This is further challenged by health's limited power over other agencies, with lead responsibility and influence over limited parts of the climate change and health picture.

Other challenges are associated with meeting short to medium term commitments (for example MDGs) while strengthening the essential public health framework (workforce, resources, information and data systems, laboratories) for understanding, assessing and acting in the long term. Furthermore, adaptation actions by others can potentially undermine health gains in some areas or create new health impacts requiring action.

However, with these challenges, many opportunities for action have also been arises. Bangladesh has a strong platform on which to advance climate change adaptation, particularly in the water and health area. It has developed a NAPA and associated strategy and action plan, which clearly identifies the need for cross-government awareness and action and identifies climate change focal points in sectoral agencies. Its Poverty Reduction Strategy identifies strengthening local government as one of four priority objectives, which is critically important for climate change adaptation. Furthermore the PRS has numerous cross-references to climate change AND acknowledges that water quality and supply is a key aspect of development. Furthermore, the Water Management Strategy clearly defines provision of safe water as a policy objective, providing an impetus for strong collaboration between the Water Resource Management sector and the WASH sector. The government WASH sector in Bangladesh is also proactive with developing and reviewing policy, including Vetting Guidelines that include climate change considerations for infrastructure projects. Furthermore the WASH sector includes significant NGO input and support which provides useful resources and capacity for strengthening climate change adaptation activities.

This section provides some discussion of the key issues for the health sector in terms of climate change adaptation and makes a series of recommendations for future activity.

4.2 Defining the climate change health sector

Population health is influenced by a wide range of factors and climate change health impacts include a diverse range of issues. If 'health' is to engage effectively in climate change adaptation processes and its voice be heard with regards to resourcing, policy integration and community engagement, it is necessary to clearly define the stakeholders involved in the climate change health sector so as to provide other, non-health stakeholders with a single focal point on which to engage about health issues. Consideration should be given to a coalition within government, from the NGO sector, from the community sector and the research sector. Local government needs to be a key partner. However, who is involved in the 'health sector' group needs to be clearly determined by the goals and purposes of the group.

4.3 Gaps in knowledge

Based on the limited Bangladesh health studies, the emerging peer-reviewed scientific literature on impacts and the global climate change and health activity, a number of areas that require further consideration in a research context are identified as:

- Lack of knowledge/focus on **extreme temperature** –some evidence of impact in an urban poor setting (eg. extreme heat mentioned by Jabeen and Johnson (2013), and extreme cold informally through media) and in a rural area by Haque et al (2013), but limited evidence of impact or action.
- General challenges associated with **urban poverty and health**, particularly given the high and growing populations in informal settlements and in anticipation of continued rural-urban migration, some of which may be associated with climate factors.
- **Mental health** issues associated with social changes arising from climate change is an area worthy of further investigation. Evidence from other countries, such as drought impacts in Australia suggests that mental health issues are significant.
- **Food borne illness(FBI)** – given relationships derived in other countries that suggest a linear dose-response relationship between average temperature increases and increased salmonella risk what is the likely impact on temperature rise on FBIs in Bangladesh? Is there existing surveillance to be able to identify existing prevalence and relationship with temperature?
- Health effects following natural disasters – **natural disaster epidemiology** – more detailed characteristics of impact (eg injury – where on body, based on what in flood, drowning – why) with more analysis of vulnerability (age, gender, SES), more detail on lag times (eg water-borne disease). This would allow for more sophisticated and targeted health programs for prevention.
- **Health service access and impacts** – how does climate change influence health services, particularly in the most vulnerable regions and for the most vulnerable populations (eg. women, children, elderly, those with existing conditions etc)?
- While much is generally known about relationships between climate change and climate sensitive diseases, a more accurate understanding of existing relationships will help to project future impacts. This is currently **limited by data availability**, particularly at a dis-aggregated level.

A national research plan that also considers the WHO (2009) review of research needs should be developed by appropriate government and research sectors collectively in order to provide research outputs that inform adaptation policy and practice.

4.4 Prioritizing health issues for focus

The WHO categorisation of health into 3 key areas relating to: environmental changes, extreme events and social changes serve as a useful starting point for health prioritization.

Such an analysis will require analysis of strength of the existing health relationship (from local or international research), consideration of local impacts, directly related to environmental changes at a local/regional level, regional impacts that may be more relevant for extreme events and national impacts that may be more associated with social issues of overall vulnerability improvement, livelihood losses and population displacement. Of course existing mechanisms for responding to health impacts should also be assessed to avoid duplication of effort. For example, the Disaster Management system appears to have considerably reduced the health impacts of extreme events and hence the acute health issues relating to extreme events may not require additional work. The longer term issues of health service delivery and mental health may however require further analysis.

The process of prioritization needs to be informed by a vulnerability assessment process. However, the absence of quality and/or long-term data on key indicators of climate change or health impacts or modifying social factors, should not limit the conduct of a timely assessment. There is much guidance provided by WHO, EU and others (eg Spickett et al, 2013) on vulnerability assessment methodology that effectively uses qualitative and semi-quantitative methods to identify priorities for adaptation action.

Furthermore, in the absence of high quality data, quantitative models with large uncertainty in health outcome predictions and significant contributions/confounding by other factors that are not easily measured may in fact require significant resources with limited usefulness of outcomes.

Not only should the climate change health sector focus on better understanding health impacts, it also needs to prioritize the way in which it considers climate change adaptation. For each priority health issue: what mainstreaming opportunities are there? What specific projects might need to be done? What are the system strengthening needs?

Also what might be the research needs other than specific health issues? Issues like data systems, staff training needs and assessment methodology may require some research effort. WHO (2009) also provides some useful research guidance applicable to the Bangladesh context. The development of a national research agenda may provide a useful platform for prompting coordinated, needs-based, strategic research action.

4.5 Who 'health' should engage with? What opportunities are there for the health sector to advance climate change adaptation?

The climate change health sector needs to engage in two distinct arenas - within the health sector and with other non-climate change health agencies and stakeholders.

4.5.1 Within the 'climate change health sector'

Within the health sector, there are many units and entities that are either impacted by climate change or can influence adaptation practice. In Bangladesh, climate change sensitive health issues are not the sole domain of the central health agency so strong engagement between relevant areas might include those that have responsibility for:

- Health services infrastructure (for example where to locate and how to design new buildings, how to improve resilience of existing buildings, planning for patient transport services) ;
- Health services and public health staff capacity (for example, amount of staff, training of staff to respond to extreme events, training of staff to conduct risk assessment, policy development etc)
- Surveillance systems – coverage, scope, interrogation of data, sustainability
- Data collection systems – quality, coverage, scope, sustainability
- Information systems – technology, coverage, sustainability
- Food safety – assessment, science, regulation and enforcement
- WASH policy and programs and regulation
- Non-communicable diseases (such as mental health issues, extreme-temperature related illness) – policy and programs
- waste management (reducing breeding habitats for vector-borne disease, disease spread, water contamination etc)

The vetting guidelines for WASH infrastructure provide a useful model of how 'within health engagement' can improve climate change adaptation. A similar approach could be used for vetting health infrastructure.

4.5.2 Outside the 'climate change health sector'

Better engaging outside of the climate change health sector will be critical for successful health influence on climate change adaptation in Bangladesh. Lessons can be learnt from the WASH area where WASH objectives have been integrated into National Water Management Policy and Plans and also in National Development planning. Water supply is projected to be such a critical issue that a 'climate change health sector' needs to engage in high level decision-making about future water demands and supplies to ensure water safety and security for human health.

Similarly, food security will be important and decisions about energy and water inputs, types of cropping etc, need to be made with health input so as to ensure maladaptation does not occur and the nutritional needs of the population can continue to be met.

Engagement with local government must be a high priority. Providing guidance, training and resources, such as guidelines (eg. vetting guidelines, assessment guidelines, and monitoring

guidelines) to assist them to conduct assessments and projects at a local level is critical for effective climate change adaptation.

Other important, yet less obvious areas of potential engagement include:

- With the ***environment sector*** to ensure that climate change and health issues are considered in the assessment of large scale projects that may be subject to environmental impact assessments
- With the ***public works, transport and housing sector*** to ensure that public infrastructure and domestic dwellings are designed, built and maintained in a way to minimize vector breeding sites
- With ***workplace health and safety agencies*** to encompass heat wave response into work protocols and processes
- With ***the NGO sector*** to ensure that climate change adaptation is embedded into design and implementation of community projects (eg WASH). The ORCHID project conducted by DFID (Tanner et al, 2007) provides useful guidance on consideration of climate change adaptation into donor projects in Bangladesh.

4.6 In what capacity should the health sector engage?

As a sector, health needs to consider the roles it currently has and what opportunities there are to expand these roles in the future, giving due regard to existing relationships and influences between agencies, resources, staff capacity and political interest. Potential roles include:

- **Leader** of a specific policy direction/strategy (eg CC and Health Adaptation Plan)/program, research program
- **Advocator** for climate change and health issues to be considered in short, medium and long-term planning decisions, and in the breadth of activity from policy to program design and implementation
- **Regulator and/or advocator** for climate change adaptation and resilience to be incorporated into NGO projects that relate to health (eg WASH, vector control)
- **Coordinator** of climate change and health related activity
- **Contributor** to other agency policy/strategy development
- **Guideline developer** – for example, to assist other agencies (eg local government) to conduct climate change assessments for improving resilience of WASH programs
- **Assessor** of plans, programs, strategies to identify potential health risks and maladaption impacts on health
- **Disseminator** of information on climate change and health impacts
- **Trainer** of staff from other agencies about health risk assessment, vulnerability, health promotion, community engagement.

Health must identify from other key policies/plans/strategies their best leverage points for advocacy and active engagement to both i) promote positive health outcomes and ii) reduce potential negative health outcomes.

Training and capacity building will be crucial for health's effective engagement in climate change and health adaptation. As climate change adaptation development spans both vulnerability assessment and strategy assessment and development and is based on scientific projections for environmental parameters, training and capacity building should be provided for health professionals in key areas of:

- Climate change science
- Risk assessment
- Vulnerability assessment
- Health impact assessment
- Risk communication
- Community engagement
- Policy assessment and development
- Monitoring and implementation

A longer training program could also include more advanced training in concepts relating to research synthesis, program evaluation, cost-benefit analysis, program logic, advocacy and leadership.

The ways in which such training and capacity building could be delivered include:

1. Formal university courses and post-graduate programs
2. Short courses
3. On-line training modules
4. Staff exchange with international and or other national agencies
5. Working directly on climate change projects with experienced professionals

4.7 Where health should engage?

The scale of engagement needs to be considered during decision making and influencing climate change adaptation. What influence and/or leadership can 'health' have at a local and national level and how can it use international scanning to benchmark approaches and monitor progress. An illustration of activity and decision-making at different scales is provided in Figure 4.1.

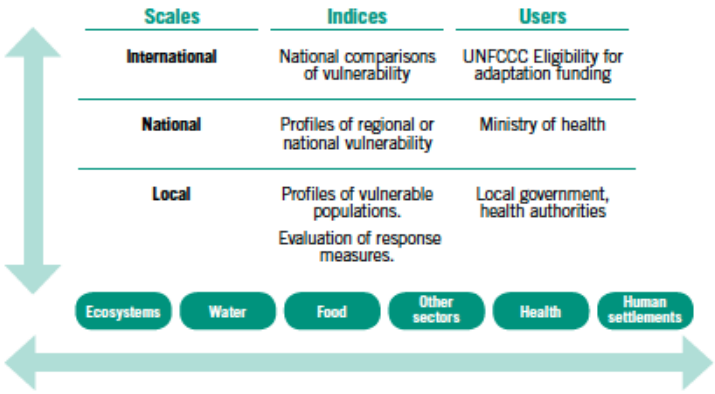

Figure 4.1 – Decision making and activity at different scales (Source: Kovats and Chalabi, 2008)

In the Bangladesh context, Figure 3.4 illustrates the different layers of government activity and provides a starting point for consideration of the types of issues and at what level within government health can engage.

There are obvious links between climate change and health impacts and development planning, particularly for the less direct issues of livelihood change, population movement and urbanisation. Ensuring that such issues are included in high level development policy and planning processes will be important for ensuring legitimacy and resourcing. One development planning example of this that is currently occurring is the requirement for all sectoral projects submitted for inclusion in the Annual Development Plan to include consideration of climate change. This is a requirement by the MoEF and guidance has been developed by that agency to assist sectoral agencies to comply.

The different sectoral policy and programs of relevance for the priority health areas also need to be examined for opportunities to influence practice, ie mainstreaming (eg refer to the UNDP-UNEP (2011) document on mainstreaming for further guidance. At a higher policy level, this will identify what types of issues might need to be influenced, and at a programmatic and action plan level, this might include what processes, protocols and regulations might provide opportunities for influence. The vetting guidelines developed by DLGRDC for consideration of climate change into WASH projects are an example of one approach used.

The ***time dimension*** is also worthy of analysis. What can be done about existing infrastructure, programs and projects to make them more 'climate resilient' and what can be done for future infrastructure, programs and projects to ensure that they consider climate change impacts and consequent adaptation measures into their design and implementation.

For the important water area, UN Water (2009) has identified 5 key areas for water adaptation:

1. Planning and applying new investments
2. Adjusting operation, monitoring and regulation practices of existing systems to accommodate new uses or conditions
3. Working on maintenance, major rehabilitation and re-engineering of existing systems
4. Making modifications to processes and demands for existing systems and water users
5. Introducing new efficient technologies

Health has a legitimate role to ensure a healthy and secure water supply and sanitation system and hence could engage within each of these adaptation areas to ensure activity doesn't inadvertently adversely impact on health (eg. maladaption) and to ensure that health protection considerations relating to water quality are not ignored.

Acknowledging and identifying the complex and interacting determinants through which health is affected by climate change will be a first step in assessing opportunities and identifying priorities for the most effective health engagement in climate change adaptation. Out of this process indicators for climate change and health can emerge. A review of the numerous frameworks available for contextualising health indicators recommends that the DPSEEA framework is the best for considering climate change and health impacts (Hambling et al, 2011).

4.8 Recommendations

4.8.1 For the health sector

- Identify a central point/agency/organisation to represent the span of health interests relating to climate change that considers the breadth of health issues provided by WHO (2009) and incorporates the social issues identified by WHO et al (2013).
- Engage in four distinct action areas:
    - **Research** – health vulnerability and impacts and effectiveness of adaptation responses
    - **Awareness** raising and capacity building with community and other sectors about health and climate change
    - **Integration of climate change** into health policies within the health sector and system
    - **Integration of health** into climate change related adaptation and mitigation policies
- Build on the existing evidence base of health impacts of climate change, existing adaptation options and their impacts through a mechanism such as the development of a national research agenda and considering the types of research areas identified by WHO (2009).
- Draw on principles and examples provided by global guidance (eg WHO, UNDP, EU) to identify vulnerable regions or 'hotspots', prioritize health risks for action and then develop a series of appropriate short, medium and long term actions within an implementation framework
- Where possible, modify existing health infrastructure and basic service infrastructure to make it more resilient to projected changes, and develop systems and approaches to include climate resilience into future infrastructure and system design
- Develop a framework for monitoring, evaluation and review that acknowledges the rapidly changing knowledge base relating to impacts and adaptation effectiveness and the iterative nature of adaptation.
- Support and resource local government to engage in, and where necessary lead, climate change adaptation projects related to health
- Build the capacity of health professional staff to advocate, lead, coordinate, plan or implement climate change and health adaptation activity.

4.8.2 For WASH

- Improve engagement with the broader water management sector to ensure that water for protection of human health is a priority water use now and in the future.
- Consider engaging with the water management sector regional management plan process to identify and prioritize those regions with significant water management issues, now and into the future.
- Encourage routine assessment of vulnerability reduction by WASH projects through utilisation of the WHO Vulnerability Reduction Assessment tool or other similar tools
- Coordinate and synthesise the learnings from the many WASH projects (NGO and government activity) implemented in the community to identify effectiveness of adaptation actions with a view to providing more evidence-based guidance
- Develop mechanisms for assessment of maladaptation – how can Health/WASH routinely engage with processes of other agencies to check for unintended health impacts of climate change adaptation activities in other sectors (eg. industry, agriculture).

- Share the learnings from some of the existing government activities (eg. Including climate change considerations into Vetting Guidelines) in order to promote opportunities for mainstreaming CCA actions into other health related areas (eg Vector Borne Disease, heat wave consideration)
- Utilize the work of WHO/DFID (2013) to conduct an assessment of climate change resilience of WASH projects in high risk regions or 'hot-spot' areas
- Utilize the work of WHO/DFID (2013) to design criteria for assessing climate change resilience of WASH projects in the Bangladesh context across the two time dimensions: for existing programs and infrastructure and for future programs and infrastructure.

4.9 The way forward

This document has provided an overview of methodological issues relating to climate change adaptation and health and identified examples of existing climate change and health adaptation strategies from around the world. It also provides the basis for understanding the policy setting for climate change and health adaptation in Bangladesh with an emphasis on WASH issues. It has primarily used information available in the public domain, with little consultation with key stakeholders. It provides a series of key recommendations for the health sector and the WASH sector which will contribute to improvements in climate change and health adaptation practice and support the establishment of a more formal process of adaptation plan development and implementation.

In order to develop a climate change and health adaptation plan for Bangladesh, the stepwise process identified in Figure 2.2 and recommended by WHO (2010) should be adopted with urgent priority given to the critical work on framing and scoping the assessment given. This would need to involve the key stakeholders as a starting point in order to define the task, decide on the scope and approach of the assessment, the policy context, the project team and project plan, establish a stakeholder process and develop a communications plan. The development of a specific health adaptation plan will need to occur within the broader climate change adaptation work undertaken under the leadership of the MoEF so as to avoid duplications and complement broader efforts.

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