Climatic Change (2016) 138:551–566
DOI 10.1007/s10584-016-1745-7

Health sector preparedness for adaptation planning in India

Purnamita Dasgupta[1] · **Kristie Ebi**[2] · **Ishita Sachdeva**[1]

Received: 23 December 2015 / Accepted: 8 July 2016 / Published online: 20 July 2016

Abstract Developing countries face substantial vulnerabilities to the current and projected health risks of climate change. The paper explores some key elements for health care system preparedness and adaptation planning for heatwaves, flooding and cyclones, illustrating the constraints faced in the Indian context, by analyzing data from a field study. The barriers are not insurmountable and many opportunities exist in building climate resilient infrastructure, improving intersectoral organization, resource planning, and framing health policies and programmes that mainstream climate risks. This is the first comprehensive attempt to collect and analyse data on morbidity, mortality, and extreme events, supported by intensive primary survey based data on the preparedness of the health care system to manage risks in India. Recognizing the importance of specific climatic events such as heatwaves, systematic documentation and assessment of risks with associated morbidity and mortality, and collaboration across relevant departments are instrumental in framing an appropriate adaptation plan.

1 Introduction

The current and projected health risks of climate change are substantial in low- and middle-income countries, requiring prioritization of overarching goals, setting of specific targets within those goals, and making available the human and financial resources to achieve them. India is already experiencing the impacts of extreme weather and climate events, including heat waves, floods, and storms (Ramana Dhara et al. 2013; Knowlton et al. 2014; SEARO 2015), with associated morbidity and mortality. The paper explores some key elements for

Electronic supplementary material The online version of this article (doi:10.1007/s10584-016-1745-7) contains supplementary material, which is available to authorized users.

✉ Purnamita Dasgupta
purnamita.dasgupta@gmail.com

[1] Institute of Economic Growth, Delhi, India

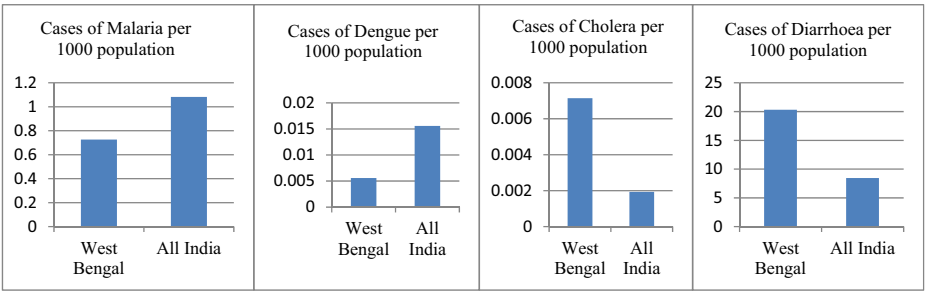
[2] Department of Global Health, School of Public Health, University of Washington, Seattle, WA, USA

health care system preparedness and adaptation planning for extreme events, illustrating the multiple interacting contexts within which health systems adaptation takes place in a developing economy, by analyzing data from a field study conducted in the state of West Bengal, in eastern India.

West Bengal is 2.7 % of the geographical area of India and 7.6 % of its population (GOI 2014a).It stretches from the Himalayan range in the north to the Bay of Bengal in the south, with varied biophysical and climatic conditions including hilly terrain, forested areas, and a 950 km long coastline (GOI 2000).It is the fourth most populous state and the sixth largest in terms of domestic product. A large area of the state is vulnerable to floods, heatwaves, and cyclones. Maximum and minimum temperatures during 1960–1990 show that several districts face markedly above normal (≥5.1 °C) and appreciably above normal (3.1–5 °C) temperatures during April and May, and can reach a high of 45 °C,which is the official government definition of a heatwave in any location (GOI 2016a). Bankura district, for instance, experienced ten heatwaves during this period (Online Resources 1, 2).The state has 37,660 sq. km of flood prone areas spread over 111 administrative blocks and 15 districts, covering most of the state, with more than 10 million people at risk of being affected by floods, cyclones, and landslides. During the 41-year period from 1960 to 2000, there were only 5 years without severe flood events (GOWB 2015).

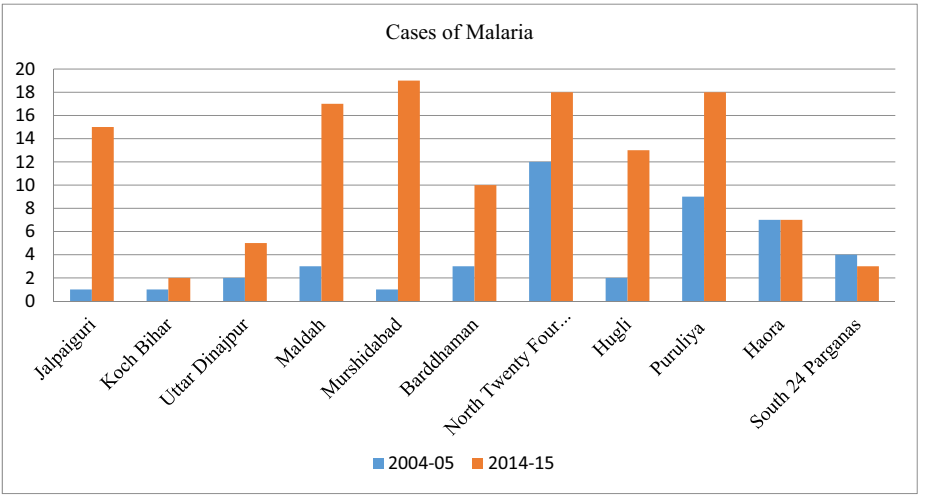
Changes in temperature, precipitation, and other weather variables can affect the incidence, geographic range, and seasonality of climate-sensitive vector-borne and water-borne diseases, such as malaria and diarrhoeal illness; extreme precipitation and cyclonic activity can increase outbreaks of infectious diseases; and increasing temperatures increase the risks for heat-related morbidity and mortality (Watts et al. 2015; Hales et al. 2014; Smith et al. 2014).The association between vector-borne diseases and weather variables over the period 2008–2012 indicates changing temperature and precipitation patterns are increasing the incidence of dengue (Smith et al. 2014). Most of the studies include South Asia and or India. Evidence is accumulating on the adverse health risks of specific climatic events in India (e.g. Azhar et al. 2014). The district level data collected in this study contributes to understanding vulnerability to climate change and its associated impacts.

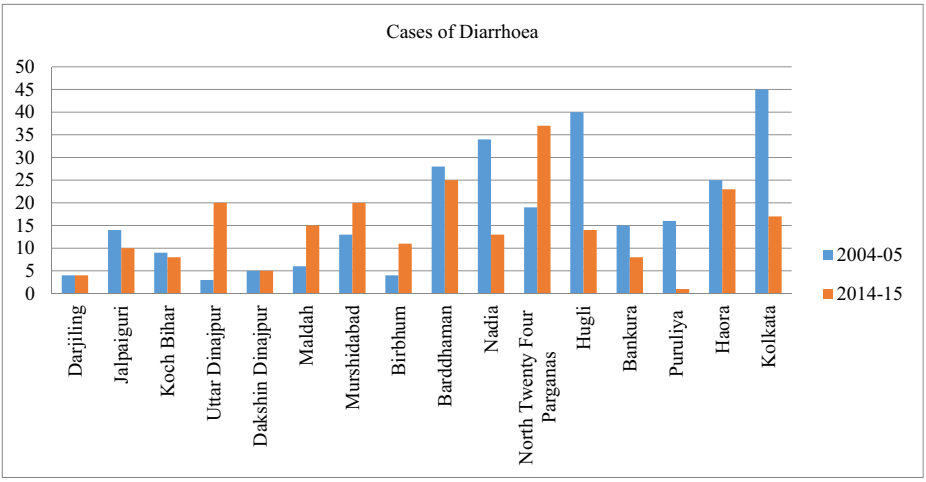
In terms of climate-sensitive illnesses, the incidence of cholera and diarrhea cases are much higher in West Bengal than in the rest of India, while dengue and malaria are lower and somewhat lower, respectively (Fig. 1). Reported cases of diarrhea decreased across most



Sources: 1. Data Book, Planning Commission (GOI 2014a) 2. Statistics Related to Climate Change- India (GOI 2013)

Fig. 1 Recent cases in West Bengal and India





Source: Authors calculations based on data from the NSS, 60th and 71st rounds. The National Sample Survey Office (NSSO) of the Ministry of Statistics and Programme Implementation (MOSPI), Government of India, collects data through nation-wide sample surveys which are meant to create and update the database in India for utilization in policy formulation and programme implementation, among other purposes (GOI 2006, GOI 2014b).

Fig. 2 District-wise cases of malaria and diarrhoea.

districts in West Bengal over the past 10 years, although malaria appears to be increasing (Fig. 2).The state lacks sufficient health care infrastructure, with high levels of shortfall in the desired norms of population coverage by Primary Health Centres (PHCs) and Sub-Centres (SCs) (Online Resource 3).

Within this context, this study collected data on extreme events, morbidity and mortality, and survey data, to understand the capacity of health systems in West Bengal to manage the health impacts of cyclones, floods, and heatwaves. This was the first effort to collect comprehensive data on extreme events and their health impacts in the state.

2 Methods

A preliminary review of state planning documents and interactions with health personnel were used to identify key elements of the study design:

- Assessment of planning documents;
- Collection of data on extreme events and disasters and
- Survey data and focus group discussions (FGDs) on the preparedness of the health sector for extreme events.

2.1 Planning documents

A review was undertaken of health plans and disaster management plans for the districts to evaluate the extent to which the plans addressed the risks from cyclones, floods, and heatwaves, and their completeness and appropriateness. The study then determined whether disaster management plans were field tested or utilized for an emergency (or emergency like-situation). Their adequacy was assessed using expert judgment based on interviews with Block Development Officers (BDOs); BDOs are involved with routine developmental work and relief and rescue operations during disasters. (Online Resource 4).

2.2 Data on extreme weather and climate events

Data on extreme events and their consequences for lives and assets were collected from the West Bengal Disaster Management (DM) department. Data were collected in person from the department records on the occurrence of natural disasters, mortality, economic losses, area, and population affected in18 districts of the state for the years2002–03 to 2013–14.The state's Health department had information and maps on past and anticipated flood prone areas; these were prepared as planning inputs for health emergencies (Online Resource 4). Monthly and daily rainfall and maximum and minimum temperatures were sourced from the Indian Institute of Tropical Meteorology (NATCOM 2009). Data on extreme events included a list of the natural disasters that occurred across districts/blocks for five years (2009–10 to 2013–14), with dates and duration of occurrence.

2.3 Selected geographic areas of study

Selected blocks from three districts of West Bengal were chosen based on frequency of cyclones, floods, and heatwaves: South 24 Parganas (cyclones), Murshidabad (flooding), and Bankura (heatwaves) (Online Resource 1). South 24 Parganas ranks first in cyclone incidence among Indian coastal districts (GOWB 2009) and experienced severe damage from cyclone Aila. The southern part of the district comprising the Sundarbans area is particularly vulnerable. Murshidabad was chosen based on maps of flood prone areas obtained from the health and DM departments. The district had a flood almost every alternate year during 2001–2010.Bankura experienced a heatwave on average every 3 years with temperatures rising to ≥ 45 °C (Online Resource 2).

South 24 Parganas, given its geographic location and high population density, is particularly vulnerable to mortality and infrastructure damage associated with cyclones. The predominant illnesses are malarial fever, diarrheal diseases, dengue, and cholera. The district is described as one

that is a constant reservoir for cholera, *Plasmodium falciparum* malaria is gradually increasing, and dengue is endemic(WBSAP 2012). Murshidabad records significant numbers of cases of malaria, and Kala-Azar associated with rising temperatures has become endemic (WBSAP 2012).When floodwaters recede, reports of snakebites and black foot diseases increase. Some health facilities are submerged during floods, increasing vulnerability to disease outbreaks (Jha and Bairagya 2011). Bankura, which is exposed to severe heat stress and drought like conditions, reports a high number of cases of malaria, non-malarial fevers, cholera, and skin diseases, with a recent increase in the incidence of dengue from 2 in 2009 to 54 in 2010 (WBSAP 2012).

Within each district, blocks representative of the specific health events of interest were selected, and health facilities sampled to ensure representation of the different levels of care upto the tertiary level for the district. The health facilities selected included the highest tertiary care centre medical college and hospital, sub-divisional hospitals, block primary health centres (BPHCs)and PHCs. There were two blocks chosen in South 24 Parganas, three blocks in Murshidabad, and four blocks in Bankura.

2.4 Survey data and FGDs on the preparedness of the health sector for extreme events

Data were collected using semi-structured questionnaires and FGDs on the current preparedness of the health system and the experiences of users and providers in managing the consequences of extreme events. Data were sought on infrastructure and organisation, resource planning, and policies and programmes (Online Resource 5).

In every district, villages falling within the geographic area served by a selected primary health centre (PHC) were identified for conducting the FGDs and interviews with key respondents. PHCs were selected on the basis of reported health events of interest, based on key informant interviews at the district and block level. Villages were purposely selected to ensure geographical diversity, from being located nearest to the farthest from the selected PHC. Every effort was made to ensure equal representation from men and women, however this ratio varied, with the share of women participants ranging from 40 % to 60 % in the FGDs. Efforts were also made to have representation from general and "backward" communities, where backward communities include certain castes, tribes, and other marginalised and disadvantaged sections of society as constitutionally provided for and identified through state lists (GOI 2016b). The FGDs lasted for 90 min to 2 hours and consisted of 8 to15 persons per village.

The tools were developed based on an evaluation of reports, and related materials from studies and face to face interviews with representatives of stakeholder groups. These were pilot tested in the three districts with one round of FGDs and personal interviews. Based on the responses, the tools were revised and translated into the local language (Bengali). The FGDs and interviews were conducted primarily in the local language, with English used in interactions with senior officials. Hand-written verbatim notes were taken of proceedings of the FGDs because most participants were uncomfortable with audio recordings.

Questions on infrastructure and organization included: location of the health facility; availability of facilities in terms of physical infrastructure and their operation, particularly during an emergency; availability of specialized medical treatment and diagnostics; and organizational structure and functioning. Information was gathered from the health officials at the state and district level, and from the health facility. Personal observations of the facility and interaction with patients and staff contributed to the findings.

Questions on resource planning distinguished between planned allocation and actual availability of resources, and included shortfalls from what senior health sector planners considered desirable. Information was collected on economic resources for surveillance, monitoring, warning, awareness campaigns; for outbreak control; and for supplies of drugs, shelter, food and clothes.[1] For human resources, information was collected on healthcare personnel and social and community level resources for response and mobilization, including participation in emergency protocols and action.

Questions on policies and programmes focused on assessing preparedness in terms of Rapid Response Teams and Standard Operating Procedures (SOP); specific plans and policies for emergency preparedness, such as in mobilizing Information, Education and Communication (IEC) support during an emergency, and stockpiling drugs, vaccines, and essential supplies; anticipated and planned for difficulties likely to occur in logistics; the role of the private sector in preparedness, if any, and plans and strategies for engaging with it; and community engagement plans.

Emphasis was laid on gathering insights and information on how systems cope in times of crisis. For instance, data collection probed whether health centres continue to be operational and to what extent during a flood or cyclone. Similarly, under community engagement, a distinction was made between how local governance institutions with multiple cross-sectoral functions such as *Panchayats* (PRIs) engage during an emergency, and how institutions tasked with specific responsibilities such as *Rogi Kalyan Samities* (maternal and child health services) cope with and plan for extreme events such as a flood. Many of the questions overlap across levels of informants, such as physical infrastructure on waste disposal, hygiene, and sanitation, availability of safe water, and personnel, allowing for triangulation of reported facts and for capturing differences in perceptions.

2.5 Survey respondents

Information was gathered at state, district, block and community levels. Sampling was purposive, using expert judgment for determining key respondents to be approached for achieving the research objectives, based on an extensive review of the secondary literature, documentation in the public domain, and key informant interviews with senior health officials The sampling structure and selection of key respondents for the primary survey followed the prevailing administrative structure for the public health system. State and medical college level hospitals constitute the tertiary level of health care, District Hospitals the secondary level, and Community Health centres (CHCs), PHCs, and SCs the primary level. These health facilities are population based, operating under predefined norms. The state Department of Health and Family Welfare is responsible for the overall administration of the system. Rural health care programmes are planned and implemented under the umbrella of the National Rural Health Mission of the Government of India. A SC is the first point of contact between society and health infrastructure. Populations to be served on average are 5000 for each SC, 30,000 for PHCs, and 100,000 for CHCs.

Comprehensive checklists and questionnaire tools were employed for interviewing health officials/staff and community representatives. The details of the respondents and interviews

[1] Surveillance involves the systematic collection of data on health determinants and outcomes. Monitoring analyzes and interprets health and environmental data, distributing information to relevant actors for timely and effective control measures.

conducted are presented in Table 1. At the state level, information was gathered from health personnel on the organizational structure of the health system, disaster management plans, and response strategies to extreme events. Information was also gathered on intersectoral co-ordination, and training and capacity building, which are mostly organized and initiated at the state health department level. At the state level, interviews were held with Officials at the Department of DM and Department of Health and Family Welfare. A snowball sampling technique was followed thereafter – after initial selection of respondents, leads were obtained to interview other relevant informants. District level officials concerned with response strategies that affect the health sector were also interviewed. Secondary data and information were also gathered.

Table 1 List of key informants

Key informants		Number of interviews
State	1. Concerned officials at the Department of Disaster Management (DM) and Department of Health and Family Welfare(DoHFW), Government of West Bengal	Total: 10 1.DM – 2 2.DoHFW – 8
District	1. Chief Medical Officer of Health (CMOH) 2. Deputy CMOH 3. District Hospital Superintendent(HS)	For each district: 3; Total = 9 CMOH – 1 Dy. CMOH - 1 HS: 1
Block	1. Block Medical Officer of Health (BMOH) 2. Block Public Health Nurse (BPHN)	For each block: 2 ; Total = 6 BMOH −1 BMOH −1 BPHN – 1
Community	1.Panchayat Pradhan 2.Members of Panchayat (MPch) 3. Religious & Social Leaders(RSL) 4. School Teachers 5. Auxiliary Nurse Midwife (ANM) 6. Accredited Social Health Activist (ASHA) 7. Local practitioners (private) 9. Villagers affected by climate change calamities	For each PHC area: Total = 28 interviews; 2 FGDs Pradhan – 2 MPch – 2 RSL - 2 Teachers – 3 ANM : 4 ASHA: 3 Practitioners - 2 Villagers: Interviews - 10 Focus Group Discussion – 2

The interviews listed above were "formal" ones, based on the sampling as per the design of the study. In addition to the above, a set of non-formal interviews and interactions also took place. These were of participants who came forward from within the community, either after the FGDs or after a formal interview with a person known to them, to volunteer information on some particular aspects of interest to the concerned respondent. These respondents were mostly ANMs and villagers, as per the classification in the table. Their responses were used primarily for triangulation purposes. In all 11 PHCs were covered for the community level interviews: 3 in Bankura and 4 each in Murshidabad and South 24 Parganas districts

The numbers interviewed for ANMs varies depending on area under jurisdiction and the place of interaction. For instance, at one BPHC in South 24 Parganas, since a training course was on for ANMs, the researchers were able to interview several ANMs, including those who had earlier served in the blocks surveyed, but were currently handling services in some other blocks. In another block, the ANMs had come to submit their reports in the afternoon on the date of survey, and here too several could be interviewed.

For administrative purposes, each district comprises of Community Development Blocks (or Blocks as commonly known), and each Block comprises of Gram Panchayats (GP). The Gram Panchayat is the local self government organization. It is headed by the Pradhan and has elected members from the village (Gram) as its constituent members. A Primary Health Centre may serve varying number of villages since it is based on an independently decided population norm and does not follow the administrative divisions.

3 Results

3.1 Evaluation of planning documents

There are limited plans and programmes to tackle the health risks of extreme events except in the disaster management plans; the latter are mostly reactive and security oriented. Standard treatment protocols exist for certain illnesses and injuries that tend to occur or be aggravated during extreme events. Although a circular on heat stress was issued in 2013 from the state directorate (GOWB 2013), there was minimal awareness about it among primary level health care providers and village communities.

The DM department maintains records of damages associated with cyclones, hail, storms, fire, and water logging due to heavy rainfall and floods. No information related to heatwaves was available. The State Disaster Management Plan does not include heatwaves in its list of natural disasters. The visibility of flooding accords it a high priority. At the State level, there are flood disaster preparedness and management plans; a cyclone Disaster Preparedness Plan; and Emergency Contingency Measures for specific districts such as South 24 Parganas.

3.2 Data on extreme weather and climate events

Observed maximum temperature trends indicated frequent heatwaves in the district of Bankura. However, the Disaster Preparedness Plan and Emergency Contingency Measures are restricted to events such as floods, with an emphasis on measures for tackling damages caused by floods. Damage reports were filed for heavy rainfall, flood, storms, and cyclones, and associated mortality recorded.

A well-functioning data reporting system across the health centres in all districts regularly reports adverse health outcomes to district and state headquarters (or daily during an emergency). The Health Management Information System (GOI 2016c) records these data, but the system does not have a separate column for reporting death or disease from an extreme event. A detailed review of the hospital level death and post-mortem registers found that heatwave deaths were rarely if ever reported. Most heat-related deaths were recorded in terms of the final diagnosis e.g. cardiac ailments. The lack of regular reporting of heatwaves and associated mortality should be a high priority for health adaptation interventions across the state.

3.3 Survey data and focus group discussions on the preparedness of the health sector for extreme events

3.3.1 Infrastructure and organisation

Heat There is ample scope for making public health infrastructure more resilient to the impacts of heat stress. For instance, in Bankura, some recently constructed PHCs have asbestos roofs and poorly ventilated rooms, forcing patients and doctors outdoors. At one PHC, a doctor was seeing patients inside, with patients carrying their saline bottles outside to seek shade under the trees. Some respondents in Murshidabad also reported discomfort during summer months. Apparently, doctors were required to see patients in the open space on the ground floor of a flood centre building, because patients were too hot inside the health centre building. Putting in place cool rooms or green roofs could facilitate adaptation.

Flood There was detailed identification of flood prone areas and vulnerable population, which is an important step for managing flooding risks. Although there was fairly reasonable guidance on tackling floods and rapid response teams were established, the inclusion of resource (including manpower) planning in accordance with the mapping was rare and intersectoral co-ordination lacking. Key concerns in the district of Murshidabad included a shortage of staff at all levels in all the blocks. Infrastructure was moderate to poor in most places, and was not designed to be flood or cyclone resistant. Shortages of electricity were also an issue. A critical feature is that many BPHCs and PHCs are located near low-lying areas and are prone to flooding. PHCs built near water bodies like ponds face the threat of being submerged during floods.

Cyclone In South 24 Parganas, the infrastructure deficit was the most severe, attributable partly to the difficult geographic conditions. The deficit ranged from PHCs that remain without electricity for up to 24 hours to areas with very restricted access to potable water. In discussions with respondents, problems of severe and disrupting shortages of electricity, drinking water, public transport, and road infrastructure were dominant. Remoteness and inadequate connectivity with tertiary level health facilities and inadequate generator back-ups for electric power were recurrent themes that hampered health centre functioning. Most respondents felt reasonably confident that mortality rates would be lower if a cyclone of the strength of Aila hit the region, because of an increase in "*pucca*" (brick, mortar/ cement) constructions for houses, replacing earlier *kuchha*[2] and semi-kuccha constructions. However, there were clear apprehensions about severe morbidity arising from the vulnerability to cyclones.

As the study team itself experienced during the monsoon season, many places became inaccessible for long stretches due to non-availability of metalled roads and navigability of waterways being hampered by the variability of tides and currents during excessive precipitation events and cyclones. In places, roads from the *ghat* (riverside) to the health centres are *kuccha*[3] or non-metalled. Several staff stated that poor connectivity affects the discharge of their duties and affects patients. During an emergency, people are exploited by boatmen who overcharge for transportation. For instance, at one PHC the respondents stated the nearest health facility was either Gosaba (BPHC - a travel time of two and a half hours) or Canning (Hospital – a travel time of four and a half hours), both requiring at least partial access via waterways. Since the Gosaba BPHC could not cater to all health care needs, patients were generally directed to the Canning hospital. The charges for emergency transportation could be three times the normal charge, constituting a week's earnings for the patient.

On the positive side, almost all the facilities reported a 24-hour back up provision for electricity to maintain cold chains(e.g. for vaccines, refrigeration) and emergency lighting. Across districts, most health facilities at the block and village level reported sufficient space for adding up to ten beds for in-patients during emergency situations, and reported that residential medical and health staff were available to cater to routine needs during odd hours.

[2] Houses with walls and roofs made of materials such as mud, unburnt bricks, bamboo, reeds, etc. (Census 2011a)

[3] Typically such roads are constructed using crushed rock or gravel material such as coarse sand or small stones, as distinct from roads provided with a bituminous surfacing (Census 2011b). These roads may or may not be functional throughout the year depending on the material used and the weather conditions.

3.3.2 Resource planning

Heat In Bankura, some public services such as courts and hospital OPD hours open earlier in the morning because of the high summer temperatures. Despite this, there is no emphasis on concrete measures to manage heat stress directly at health facilities. IEC materials related to heatwaves were few in number. Respondents across districts felt the utilization and distribution of IEC materials could be improved. None of the respondents had any training on the risks of heat. There was ample evidence of a lack of focus on the public health aspects of heat.

Flood Respondents felt that floods caused disruptions and dislocation on a large scale, with substantial visibility, prompting an immediate population level response. In overall terms, increased preparedness for flood events was evident from the responses of key informants, the flood action plans, and from the high levels of awareness of flood response strategies among health staff at all levels in Murshidabad. There was a perception among communities that health officials are co-operative and hard working, with a high level of willingness to work.

Cyclone BDOs were credited with taking initiatives such as training of male and female civil defense volunteers from different villages. However, concerns were raised that continuity of training was lacking, as was the supply of speed boats (in the South 42 Parganas area) and allocation of funds for sustaining the efforts. Among the most visible initiatives were the construction of multipurpose cyclone shelters and flood centres, in which substantial progress was reported. While there were laudable efforts such as providing hand-pumps on elevated platforms or higher floors to ensure supplies of drinking water in case of a flood, accessibility to such centres from surrounding villages remains an issue due to the poor road conditions. Another concern raised in the Sunderbans region was that multipurpose cyclone shelters were not always planned for or built in close proximity to existing BPHCs or PHCs. There are District, Sub-division, and Block Action Plans for flood, with meetings held with all relevant departments during the pre-monsoon period. However, many senior officials stated that a severe lack of resources resulted in inadequate preparation to tackle another cyclone-like emergency.

There were very positive comments about health officials and staff during times of natural disasters, in terms of their willingness to work and go the extra mile (for instance, extended work hours without additional remuneration and provision of personal services and equipment like beds, nets, provisions, cooking and cleaning voluntarily beyond specified responsibilities). However, practical issues such as the shortage of staff and funding to support additional preventive measures were a persistent challenge even in areas experiencing regular flooding events. Most health care facilities reported adequate stocks and stockpiling strategies for medicines. In a few places where shortages were reported, these were a result of geographic remoteness and transportation challenges. Although here too, most interviewees reported health centres did their best to help them overcome these constraints, sometimes with the help of community representatives and well-wishers with personal transportation options.

3.3.3 Policies and programmes

Heat Heat stress conditions were a low priority in the State and district policies and reporting. The prevalent community understanding was that management of heat stress was a private matter; it is up to the individual how s/he deals with it. The majority of community level

responses indicated most heat stroke deaths occurred outdoors on the road or in agricultural fields, and were usually not reported.

Flood Emergency contingency measures were in place for managing floods in Murshidabad District. Lessons learnt from past floods led to enhanced preparedness at the district, sub-division, and block; each level has an action plan. Meetings are held with all relevant departments during the pre-monsoon period for orientation and preparedness for action.

Cyclone The Sunderbans area was an area of high focus after cyclone Aila, with efforts launched to rehabilitate and improve resilience. These ranged from improving livelihoods, reconstructing homes, to more health facilities, and substantial academic research interest. The most important adaptive intervention to reduce mortality was perceived to be the building of homes with more permanent construction materials expected to withstand the impact of the cyclone. However, interviews with respondents revealed a significant lack of confidence among government officials and community representatives about the consequences if another cyclone were to occur. A recurring response was that the district, sub-division, and blocks were no better prepared than before. For instance, respondents pointed out that one PHC, submerged up to the first floor for 2 days after cyclone Aila, continues in its old location. This underscores the need for interventions that consider climate sensitivity. However, health facility providers and users in the South 24 Parganas district spoke positively about the significant NGO presence and the role they played in community mobilization, in providing free clinics, mobile medical teams, and creating awareness. This was unique to this region.

None of the respondents in any district reported any regular risk assessment activity. The lack of resources for surveillance, monitoring, and reporting activities was reported in all three districts, although some like Murshidabad had some resources available for awareness creation activities. More field testing of disaster management plans and targeting of vulnerable population was called for. The flood action plan in Murshidabad, for instance, targets vulnerable populations. This was not the case in Bankura because heatwaves do not get the same attention. Orientation classes for the awareness and management of climate and weather-related illnesses concentrate mostly on excess precipitation and issues of water-logging. Respondents often mentioned implementation concerns and lack of co-ordination among departments. The formation of Rapid Response Teams without adequate coordinated drills was a concern across the districts. Two key positive perceptions related to the adequacy of medicines and the good intent of available staff to help out in an emergency. Two key negatives were the lack of intersectoral co-ordination and inadequacy of infrastructural and human resources to handle crisis situations. The plan of action for the health department though does recognize the need for synergizing with other departments including the State Disaster Management Authority (GOWB 2011).

4 Conclusions

While advances have been made, significant efforts are needed to increase health system resilience to climate change, including integrating health adaptation into national health planning, providing a flexible and context specific approach to health adaptation, and maximizing synergies across sectors (WHO 2014). The list of challenges and barriers is substantial, but not insurmountable. Small steps have been taken, and the rationale and need for adaptation

in public health planning is beginning to be recognized. The formulation of a health chapter in the State Action Plan on Climate Change documents being prepared by West Bengal and other states is one example of a potentially valuable initiative. Thinking has also evolved under the broad scope of disaster management, such as the setting up of Disaster Management Information Centres or Emergency Support Functions plans (GOWB 2014a) that provide details of the departmental officers responsible during emergencies. There was a fairly well established flood preparedness plan for the cyclone and tidal wave-prone blocks of South 24 Parganas, including flood microplans with information on alternate health service points in case of flooding, and actionable points for managing disasters (GOWB 2014a; GOWB 2014b; GOWB 2014c).Most of these initiatives are still evolving. A particular challenge is it is unclear where the resources to meet the identified needs will come from. Further, timelines for implementation have not been established. The situation is similar for most states in India. More importantly, a disaster management orientation does not necessarily address adaptation to increases in extreme or slow onset climatic events.

Significant challenges include how to effectively take stock of current and projected vulnerabilities and raise the human and financial resources needed for accurate, relevant, and reliable data collection, analysis, and communication. There was very little understanding of the implications of climate change on health-related developmental goals among community and health officials. In Murshidabad, recurrent floods were perceived to be effectively managed, with health personnel described as being "well intentioned" and "hard working", earning community respect. But, in reality the system is functioning with limited manpower and other resources. Community expectations were also low because the flood threat lasts only for "a few days".

Building awareness and institutional capacity to understand the linkages is a priority. Implementation and operationalization require addressing issues of infrastructure, surveillance, and provision of adequate personnel. Field data suggest that coping with existing threats is itself a major challenge in most places affected by heatwaves, flooding, and/or cyclonic activity. Reporting, monitoring, and surveillance are weak where available. Moving from a post disaster (reactive) to a planned continuous mode of adaptation to address the health risks posed by climate change calls for systematic data collection and analysis. The examples show the fragmented nature of the current response to climate-related health outcomes. The health risks that climate variability and change pose can be best managed through an integrated response that involves relevant departments in the Ministry of Health in collaboration with other ministries.

In the case of cyclones, expectations from government departments and public health care providers were much higher. Accessibility of health care facilities under normal conditions remains a challenge in many places in the Sunderbans region. Health care providers are often unable to reach remote areas, or work for reduced hours due to connectivity issues arising from tidal activity that determines the availability of ferry services. Another major area for intervention is increasing access to decentralized and renewable energy sources that could help resolve current crises with regard to lack of electricity for health facilities and residences.

Maintenance of records and registers on availability of medicines, equipment, personnel, and other infrastructure is important for assessing risk and vulnerability. There is vast scope for improvement, as was noted in evaluations of the National Rural Health Mission (RET 2011).

Heat-related concerns affected functioning of the public health system in two of the three districts, with a high awareness of heat stress among respondents. Yet, there is a lack of surveillance and monitoring of heat-related mortality and morbidity. Sunstroke/heat mortality was reported in some districts of the state of West Bengal until the year 2004. However, the data were unlikely to be complete, and data for subsequent years were not available. This

emphasizes the importance of effective surveillance, monitoring, reporting and analysis of data on heat-related cases and deaths, and associated variables. There is simply no way of assessing heat-related mortality and morbidity, and reporting formats do not mainstream these at the level of blocks or PHCs. Without this information, initiatives such as provisioning of cool rooms at health centres, distribution of bus passes to avoid exposure while travelling in the heat, creation of shelters, regulating hours for outdoor labour, or early heatwave warning systems are unlikely to occur within the "expansion of existing programmes." Awareness creation is needed among the general public and health care practitioners.

The Ahmedabad Heat Action Plan is worthy of mention because it is the first such plan in the South Asian region to prepare for heatwaves, and efforts are underway to scale up the program to other Indian cities (Knowlton et al. 2014).The plan was in part a response to the deadly heat wave of May 2010 when temperatures above45°C were recorded. The plan includes four key strategies: build public awareness and community outreach on the risks of heatwaves and implement practices to prevent heat-related illnesses and deaths; develop an early warning system to alert residents of impending high temperatures and coordinate an inter-agency response effort; capacity building among health care professionals, including training of medical and paramedical staff for managing heat-related illness; and efforts to reduce heat exposure. The initiative is still evolving, but similar plans need to be designed to tackle specific climate problems, taking note of the local context in the state.

On the planning front, State Action Plans for Climate Change were drafted under the aegis of the Ministry of Environment, Forests and Climate Change of the Government of India (GOI 2016d). Strategies, actions, timelines, and budgets were proposed in all State action plans for managing the health risks of climate change, in keeping with the overall framework. Increased surveillance is one proposed action. How these link with existing state health policies and programmes has yet to be determined, nor has the extent to which these can help address the challenges in providing better health care in a changing climate been spelt out.

A two-pronged approach could include modifying current and incorporating new strategies and measures to reduce climate-related risks under the responsibility of the National Health Mission. Public health must be central to the development of state climate change policies. State action plans– now going into the actionable phase – need to provide the impetus for intersectoral coordination. For instance, some states propose GIS mapping of access routes to health facilities, with collaboration between the state remote sensing centre and the health department, and prioritization of geographic areas based on vulnerability to climate change under the Integrated Disease Surveillance Project (IDSP) of the GOI (e.g. Arunachal).[4]The IDSP is cited in many of the state action plans as one important means for managing climate threats. District health action plans could incorporate interventions to manage the risks of climate change, which can be used to seek additional funding through IDSP under the National Health Mission. Alternatively, the state could seek additional allocations for a specific purpose such as for managing flood risks in a particular district. The state action plans on climate change also could seek separate allocations for the IDSP from the state health budgets to enhance adaptation.

Respondents across governance levels repeatedly highlighted that a critical aspect of promoting adaptation is addressing the limited availability and allocation of human and financial resources to prioritise and implement interventions to better manage the

[4] A list of the state action plans is provided in online resource 6. The plans are available online (GOI 2016d)

health risks of extreme weather and climate events, whether in terms of ensuring continuation of services such as electricity and transportation, or implementing new interventions such as cooling facilities. As the results highlight, disaster risk management needs to move beyond vertical programs focusing on coping with and recovering from the latest extreme event, to incorporate preparedness for changing patterns of extreme weather and climate events. These programs also need a more holistic approach to working across sectors to ensure the most vulnerable populations and infrastructure have the necessary resources. Establishing these interlinkages in the state action plans would facilitate their mainstreaming into district health plans, which are the most appropriate instruments for responding to health sector needs at the district and sub-district level as envisaged under the National Health Mission.

Putting together heat or flood or cyclone action plans with well-structured phases of readiness that pinpoint actionable strategies or integrate a climate component into disease tracking systems, offer opportunities for increasing resilience. In many instances, "more of the same" will be inadequate. In the Indian context, it is time to look for innovative strategies, build institutional capacities, spread awareness, and strengthen public health infrastructure, based on analyses of the current and likely future health risks of climate variability and change. This is essential for increasing adaptive capacity and resilience. There are examples of states in India that initiated proposals to enable better coping with climate-sensitive morbidity and mortality as evidenced through a critical review of the proposals made in the State Action Plans (GOI 2016d).There is evidence of good intent and examples for learning best practices, from GIS mapping of access routes to health facilities (e.g. Manipur), to spreading knowledge about climate-sensitive diseases using the Integrated Disease Surveillance Programme (e.g. Arunachal), to initiating steps for a digital database of spatial and temporal distribution of mortality and morbidity of vector-borne diseases (e.g. Karnataka) and online reporting of climate-related cases of illness (e.g. Punjab), systematic training of volunteers on public health emergency management techniques (e.g. Andhra; West Bengal), to issuing of colour-coded heat alerts (Ahmedabad), to building of disaster resilient infrastructure in a specified time frame (Orissa) and regulating outdoor working hours. A systematic documentation of the proposed initiatives and their integration into national health planning are essential steps towards increasing resilience to the health risks of climate change.

References

Azhar GS, Mavalankar D, Nori-Sarma A, Rajiva A, Dutta P, et al. (2014) Heat related mortality in India: Excess all cause mortality associated with the 2010 Ahmedabad Heat Wave. PLoS One 9(3):e91831

Census (2011a) Instruction manual for houselisting and housing census. Census of India, Government of India. http://censusindia.gov.in/2011-Documents/Houselisting%20English.pdf Accessed 25 November 2015

Census (2011b) Concepts and Definitions used in Village Directory (VD) and Town Directory (TD) of District Census Hand Book (DCHB). Census of India, Government of India. http://www.censusindia.gov.in/2011census/dchb/DCHB%202011-Concepts%20&%20Definitions%20Village%20and%20Town%20Directory.pdf Accessed 25 November 2015

GOI (2000) Compendium of Environment Statistics. Central Statistical Organization, Ministry of Statistics and Programme Implementation, Government of India

GOI (2006) NSS 60th Round - Morbidity, Health Care & Condition of the aged. National Sample Survey Organization, Ministry of Statistics and Programme Implementation, Government of India. http://mospi.nic.in/rept%20_%20pubn/507_final.pdf Accessed 20 December 2013

GOI (2013) Statistics Related to Climate Change – India. Ministry of Statistics and Programme Implementation, Government of India. http://mospi.nic.in/Mospi_New/upload/climate_change_29nov13.pdf. Accessed 20 July 2014

GOI (2014a) Data-Book Compiled for use of Planning Commission. Planning Commission, Government of India. http://planningcommission.nic.in/data/datatable/0306/Databook_June2014.pdf Accessed 12 September 2015

GOI (2014b) NSS 71st Round – Key Indicators of Social Consumption in India: Health. National Sample Survey Organization, Ministry of Statistics and Programme Implementation, Government of India. http://mail.mospi.gov.in/index.php/catalog/161 Accessed 20 November 2014

GOI (2016a) All India Heat Wave Information. India Meteorological Department, Ministry of Earth Sciences, Government of India. http://www.imd.gov.in/pages/heatwave.php Accessed 20 April 2016

GOI (2016b) Sector Overview at a Glance. Ministry of Social Justice and Empowerment, Government of India http://socialjustice.nic.in/sectorviewmain.php Accessed 20 April 2016

GOI (2016c) HMIS Standard Reports. Health Management Information System, Ministry of Health and Family Welfare, Government of India. https://nrhm-mis.nic.in/hmisreports/frmstandard_reports.aspx Accessed 14 March 2014

GOI (2016d) State Action Plan on Climate Change, Ministry of Environment, Forest and Climate Change, Government of India. http://envfor.nic.in/ccd-sapcc

GOWB (2009) District Human Development Report: South 24 Parganas. Development and Planning Department, Government of West Bengal. http://www.undp.org/content/dam/india/docs/hdr_south24_parganas_2009_full_report.pdf Accessed 15 December 2013

GOWB (2011) Plan of Action: 2011–2015. Department of Health & Family Welfare. Government of West Bengal, India http://www.wbhealth.gov.in/plans/v_11_15.pdf Accessed 2 December 2015

GOWB (2013) Circular on "Prevention and Combating Heat Stress. Office of PH & CD, Directorate of Health Services, Government of West Bengal, https://wbxpress.com/guidelines-for-heat-wave/ Accessed 20 November 2014

GOWB (2014a) West Bengal Disaster Management Plan. Department of Disaster Management, Government of West Bengal. http://wbdmd.gov.in/writereaddata/State_DM_Plan_2014.pdf Accessed 20 November 2014

GOWB (2014b) Flood Preparedness and Management plan. Office of the District Magistrate, Murshidabad, Government of West Bengal http://wbdmd.gov.in/writereaddata/uploaded/DP/DM%20Plan%20Murhidabad.pdf Accessed 25 November 2014

GOWB (2014c) Action Plan for Disaster Management along with Standard Operative Procedures. Public Health Branch, Directorate of Health Service, Government of West Bengal

GOWB (2015) Overview: West Bengal Disaster Management Department. http://wbdmd.gov.in/Pages/Flood2.aspx Accessed 8September 2015

Hales S, Kovats S, Lloyd S and Campbell- Lendrum D (2014) Quantitative Risk Assessment of the Effects of Climate Change on Selected Causes of Death, 2030s and 2050s. Geneva, Switzerland: World Health Organization http://apps.who.int/iris/bitstream/10665/134014/1/9789241507691_eng.pdf Accessed 14 October 2014

Jha VC, Bairagya H (2011) Environmental impact of flood and their sustainable management in deltaic region of West Bengal, India. Instituo de Geographia, ufu, 12(39): 283–296. http://www.seer.ufu.br/index.php/caminhosdegeografia/article/view/16578 Accessed 26December 2014

Knowlton K, Kulkarni SP, Azhar GZ, Mavalankar D, Jaiswal A, Connolly M, Hess JJ (2014) Development and Implementation of South Asia's First Heat Health Action Plan in Ahmedabad, (Gujarat India).Int J Environ Res Public Health, 11: 3473–3492. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4024996/ Accessed 11 September 2015

NATCOM (2009) Data for Regional Climate scenarios for India (PRECIS). India's Second National Communication to UNFCCC. Ministry of Environment, Forests and Climate Change, Government of India, New Delhi, India.

Ramana Dhara V, Schramm PJ, Luber G (2013) Climate change and infectious diseases in India: Implications for health care providers. Indian Journal of Medical Research 138:847–852

RET (2011) Regional Evaluation Team Reports. National Rural Health Mission, Government of West Bengal, India. http://nrhm.gov.in/images/pdf/nrhm-in-state/state-wise-information/wb/ret-reports/ret-wb-10-11.pdf Accessed 15December 2014

SEARO (2015). Review of climate change and health activities in India. Final Report, WHO SEARO, August.

Smith K R, Woodward A, Campbell- Lendrum D, Chadee D D, Honda Y,Liu Q, Olwoch J M, Revich B, Sauerborn R (2014) Human Health: Impacts, Adaptation, and Co-benefits. In: Field CB, Barros V R, Dokken D J, Mach K J, Mastrandrea M D, Bilir T E, Chatterjee M, Ebi K L, Estrada Y O, Genova R C, Girma B, Kissel E S, Levy A N, MacCracken S, Mastrandrea P R, White L L (eds) Climate Change 2014:

Impacts, Adaptation, and Vulnerability. PartA: Global and Sectoral Aspects, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge, U.K. and New York, Cambridge University Press: 709–754

Watts N, Adger W N et al (2015) Health and climate change: policy responses to protect public health, Lancet Commission. Lancet 386, No. 10006, 1861–1914 Published online June 23, 2015 doi:10.1016/S0140-6736(15)60854-6 .Accessed 14 July 2015

WBSAP (2012) West Bengal State Action Plan on Climate Change. Government of West Bengal http://www.moef.nic.in/downloads/public-information/West-Bengal-SAPCC.pdfAccessed 20 November 2014

WHO (2014) WHO guidance to protect health from climate change through health adaptation planning. World Health Organization. http://apps.who.int/iris/bitstream/10665/137383/1/9789241508001_eng.pdf?ua=1Accessed 11 September 2015