

# Children of an Uncertain Climate



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## Preface

Child health is extremely vulnerable in the Indian Sundarbans region due to its problems of geographical inaccessibility and economic vulnerability. Climate change is an extra burden to the already existing vulnerabilities. It is evident that the routine services provided by the existing health care facilities are not only inadequate to reach out to every corner of the hard-to-reach pockets with an affordable solution but also need transformative approaches to meet the changing needs and demands for health care amidst climate change impacts on the health of the islanders.

To address the problems, it is necessary to devise a separate long-term innovative plan for the health system to be climate resilient and provide basic health care services more effectively and equitably even to the climatically most vulnerable islands of the Sundarbans.

The FHS-India team has been engaged in research on the human health status in the Indian Sundarbans since 2009 and came up with a comprehensive report in 2010. A more in-depth report on the health of children of the Indian Sundarbans was published in 2013 in the name of Sundarbans Health Watch. In this present endeavor we have reflected on the pathways of climate change impacts on the health of the Sundarbans' children. This report is based on a mixed method study conducted in Sagar, one of the six most vulnerable blocks out of the nineteen administrative blocks of the Sundarbans. This study has made an attempt to find out the present condition of different aspects of child health under climate crisis, to identify the gaps in service delivery and possible ways out on the basis of scientific evidence.

This report will be useful to a wide audience, e.g., the NGOs working in this region, Sundarbans Development Board, Department of Health and Family Welfare, Government of West Bengal, the donor agencies, the regions with similar geo-climatic vulnerability in India and other developing countries as well as international academia.

We are part of Future Health Systems: Innovations for Equity, an international Research Programme Consortium (RPC) funded by DFID, UK. In India, Institute of Health Management Research University is a partner of RPC and responsible for the research in the Indian Sundarbans region with a view to protecting the interests of the poor and neglected people.

## List of Abbreviations

ANM	Auxiliary Nurse Midwife
ARI	Acute Respiratory Infection
ASHA	Accredited Social Health Activist
AWW	Anganwadi Worker
BDO	Block Development Officer
BPHC	Block Primary Health Centre
CBO	Community Based Organizations
CDC	Community Delivery Centre
CSE	Centre for Science and Environment
DoHFW	Department of Health and Family welfare
FGD	Focused Group Discussions
FHH	Female Headed household
FHS	Future Health Systems
G.P	Gram Panchayat
GIT	Gastro Intestinal Tract
ICDS	Integrated Child Development Schemes
IHMR	Institute of Health Management Research University
IMD	Indian Meteorological Department
IPCC	Intergovernmental Panel on Climate Change
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee schemes
MLA	Member of Legislative Assembly
MHH	Male Headed Household
NGOs	Non-Governmental Organizations

NHM	National Health Mission
OBC	Other Backward Class
PHC	Primary Health Centre's
PIPA	Participatory Impact Pathway Assessment
RGSRY	Rajiv Gandhi SwavlambanRozgarYojna
RMP	Rural Medical Practitioner
SAD	Sundarbans Affairs Department
SC	Scheduled Caste
SDB	Sundarbans Development Board
SHG	Self Help Group
SPSRC	State Policy and Sector Reforms Cell
SST	Sea Surface Temperature
STEPS	Social Technological and Environmental Pathways to Sustainability
TSRD	Tagore Society for Rural Development
UNESCO	United Nations Educational, Scientific and Cultural Organization



## Executive Summary

Across the world, nations are calling for transformational approaches to deal with challenges posed by climate crisis. Among the countless impacts, community health is one crucial sphere where climatic events are already showing detrimental effects. Changes in extreme weather events, under-nutrition and the spread of climate sensitive diseases are projected to increase morbidity and mortality rates, especially among children, by 2030 (WHO, 2003). In 2009 Lancet commission declared climate change as ‘the biggest global health threat of 21st Century’. The commission urged all countries to strengthen the health system to expand its reach in order to achieve SDG 3 (healthy lives and wellbeing) and universal health coverage. However, dealing with climate impacts is particularly crucial in the South-East Asian and African countries as access to resources here is sensitive to societal intersections (Sen et al., 2017). Even vulnerability to climate change differs according to social vulnerabilities which are again determined by several factors like livelihood, religion, geographical locations, gender and socio-economic statuses. Further, the intensity of these determinants of vulnerability is not uniformly distributed but varies according to the contextual realities.

The Indian Sundarbans is a typical example of a climatically vulnerable region facing geographical, socio-political and economic marginalization since the colonial period. The people are burdened with underemployment, poverty, disaster risk, ill-effects of political polarization and have erratic access to even basic services like fresh drinking water and electricity. In addition to these, local impacts of global climate change can be seen and felt in the Sundarbans in terms of sea level rise, rapid land erosion, erratic rainfall and increasing incidence of floods and cyclones. These impacts are gradually hampering the traditional agro-fishing economy of the Sundarbans and forcing the people to take to wage labour as a livelihood option, either within the island or in distant places across the country. This changing socio-economic scenario is creating some new factors along with the already existing ones to determine the health of the children of the Sundarbans.

The impact of climate change on child health is over-encompassing – controlling everything, sometimes individually and sometimes in combination with other determinants. Climatic changes are seen to have two types of impacts on child health. First is the immediate impact, for example, rise in the incidence of flood-related diseases (e.g., diarrhea and respiratory infections). The second is a long run extension of the immediate effect like erosion, flood or inundations. The coastal regions of the Sundarbans are facing a serious crunch in food resources due to loss of agricultural and fishing products as a result of frequent salinity ingressions and rapid land erosion. The economic backbone of the households, traditionally dependent on fishing and agriculture, is thus weakened, even broken,

resulting in increased social vulnerability, one manifestation of which is an increased burden of under-nutrition. Although this risk is still not well reflected in the malnutrition status of the children – due to a range of short-term coping strategies adopted by the parents – findings revealed a direct linkage of malnutrition status of the children of the studied regions with climatic vulnerability induced household food insecurity. These impacts further strengthen the vicious cycle of recurrent morbidity and under-nutrition. Nevertheless, the parents have very few choices of service delivery options in terms of both formal and informal health providers, which impact their health care seeking behaviour. The frequent climatic events also have a devastating effect on the health care delivery system in the form of loss of infrastructure and human resources and thus lesser preparedness to cope with the climatic uncertainties.

The study found that climate change in the Sundarbans is itself coming up as a structural determinant of child health, intermediating with other social determinants like livelihood, food system and health care seeking. To address these issues, a multi-sectoral approach is essential. Transformative approaches need to be taken to make every building blocks of the health system to be climate resilient following WHO's Climate Resilient Health System Framework (2015).

# Chapter 1: Introduction

## 1.1 Introduction: Climate change and risk of human health

Climate change and its consequences are expansive and all-encompassing; it is difficult to know where to begin to address it. According to IPCC 5<sup>th</sup> Assessment report, South Asian countries are now having more warm days and nights; erratic, shorter but intense rainfall and high rate of sea level rise, greater than the average rate of the last 2000 years (IPCC, 5<sup>th</sup> Assessment report, 2015). As an impact of such changes, majority of the population of South Asian regions are facing risk of life, livelihood, health and wellbeing (ibid). Decreasing but intense monsoon season and unusual heat extremes tend to make crop production and market systems uncertain. Decrease in snow melting from the Himalayas raise the sea level and reduce the flow of water into the Ganges, Brahmaputra and Meghna (GBM delta) basins. Together, they threaten to leave hundreds of millions of people displaced, without enough water, food, or access to basic services like health care.

Among the many impacts of climatic changes, community health is one crucial sphere. IPCC projects an increase in mortality and morbidity rates by 2030 (ibid) due to extreme weather events brought about by climate change and resulting in under nutrition and spread of infectious diseases. The largest health risks will occur in populations that are most affected by climate sensitive diseases such as vector and water borne diseases and those whom 'economic growth' has passed by. Climate change disproportionately impacts the economically disadvantaged and those at the lower end of the power structure (Sen et al, 2017). Hence, poor people, women, children, the elderly, people with chronic diseases and disabilities, those residing in areas with a high frequency of climate-related diseases, and people exposed to extreme heat or increased weather variability are the most vulnerable to the adverse impacts of climate change (ibid).

The Sundarbans is one such vulnerable region in the GBM delta where climate change has been showing its impacts since the last four decades, especially in the island pockets on the sea mouth and the river (IPCC 2015; Hazra et al, 2010; WWF, 2011, CSE, 2012). A recent study (Brown et. al, 2018) on the GBM delta, which contains the Sundarbans mangrove forest, found that the delta is at high risk of long-term flooding, even if the world's temperature gets stable. The Indian part of the Sundarbans is highly vulnerable to land erosion as it is losing its mangrove cover rapidly (Giri et al, 2007). The changes, especially in the islands like Sagar, Nayachar, Ghoramara and New Moore, are resulting from changing dynamics of the Bay of Bengal as well as its numerous rivers with major consequences on the accretion and erosion dynamics of the delta (Mukhopadhyaya et al, 2015). The most significant land erosion has occurred on the Ghoramara Island between 1967 and 1995 (Ghosh and Sengupta 1997; Ghosh et al 2003). The western part of the island has undergone extensive erosion whereas the

eastern part is gaining land mass. The net loss of land on the island is 3.19 km<sup>2</sup> in the last 28 years (Mukhopadhyaya et al, 2015). Mukhopadhyaya et al observed a close relationship between sea level rise (SLR) and coastal erosion while moving towards east from the west. According to the study, the average SLR is much higher and relatively increasing near the Sundarbans when compared with the global average (IPCC, 2007; Mukhopadhyaya, 2015). The increasing SLR is also resulting in thermal expansion of sea water which has further impacts on erosion activities (ibid). The net result of such climate change manifestation is reflected in the disappearing islands like Lohachara, Suparibhanga and New Moore within a span of last 40 years. The island of Ghoramara, which has become roughly half of its original size in the last 15 years, will soon feature on the list of disappeared islands in the Indian Sundarbans (Hazra et al, 2010).

### **1.2 Climate change and child health:**

Global evidences suggest that children are most likely to experience adverse health effects caused by environmental factors (Neira et al, 2008). Hoddinott and Kinsey (2001) found that the 1994–95 droughts in Zimbabwe significantly lowered annual growth rates for children, with the effects still present four years after the drought. Similarly, Yamano et al (2005) found that the drought in Ethiopia from 1996 to 1997 resulted in increased rates of child stunting. Alderman et al (2006) established a causal relationship between child's height and adult's height and schooling by exploiting exogenous events such as the civil war and droughts in Zimbabwe. Datar et al (2013) examined the impact of natural disasters on children's health in rural India at the household level through a time series analytical approach, which identified three-way impacts of natural disasters on children: 1) direct impact on morbidity and mortality, 2) inadequate supply of health care and 3) negative impact on demand for health care due to decreasing socio-economic status. These factors vary according to the individual's and household's structural characteristics, such as child's gender and age, mother's education, a household's ethnic status, and between northern and southern Indian states. These various threats to health are now getting catalyzed, especially for the children of lower-income countries, due to worldwide climate change (Yoko A., Goodman D., Parker D., 2009). As the health of these children majorly depends upon their social determinants like poverty, clean water, poor sanitation and inadequate healthcare systems, they became the worst sufferers (McMichael, A. et al, 2004). Also, as the changes will continue in the foreseeable future, impacts on children's health like physical and mental trauma from extreme events; diarrhoeal, parasitic, vector borne and allergic infections; under-nutrition and stunting are likely to increase (Smith, K.R. et al, 2014; Sheffield, P.E et al, 2011).

A series of Future Health System studies in India has revealed that the people of the Indian Sundarbans are suffering from an extra burden of communicable and non-communicable diseases and under-

nutrition (Kanjilal et al 2010 and 2013). Sub-optimal and mostly inaccessible health care delivery system is grossly inadequate to help people deal with their health challenges (ibid). Evidence from Future Health System's studies has also revealed the plight of the most vulnerable and sensitive group in the population in this regard are the children (Kanjilal et al, 2013.) The study "*How healthy are the children of Indian Sundarbans?*" indicates the link between rapid climatic changes and poor health status of the Sundarbans' children (Kanjilal et al, 2013). The evidence, however, has triggered more implicit queries like how do these adverse climatic changes like erratic rainfall, erosion, sea level rise or frequency of cyclones and floods impact the children's health? Are these impacts equally distributed across the region or across the economic and social segments? How is the existing health care delivery system responding to these climatic threats?

The aforementioned questions have immense significance not only for the Indian Sundarbans but also for the Indian context as India's disadvantaged regions have been identified as one of the climate change hot spots in South Asia by the latest report of the World Bank (World Bank, 2018).

With rising awareness of climate change impacts among both national and international bodies, stepping up the health system's response has now become a major goal. This is also in alignment with Sustainable Development Goal, 13-the climate action. The key focus of climate action and/or climate sensitive health system efforts is to address the vulnerabilities faced by the communities with regard to climatic and environmental consequences. The efforts of finding new directions would encompass social, economic, technological, and political strategies, which is a necessity at all scales of the system. Our report is an endeavor to explore the relation between climate change and child health, a little-addressed but significant dimension of the health system of the Indian Sundarbans. We have tried to answer the previous questions with a mixture of qualitative and quantitative tools and techniques in one of the most climatically vulnerable blocks of the Indian Sundarbans-the Sagar Island. The report is expected to provide evidence support to increase performance of the health system amidst climate change in West Bengal where the Sundarbans has been taken as a representative case. The report is well aligned with the Central and State Government's newly recommended programme under National Climate Action Plan and Mission on Health Programme, as it provides empirical evidence on sub-district level health and nutritional vulnerabilities to climatic adversities. Hence, providing evidence based policy recommendations is an integral objective of the present research. Globally, the research will inform the emerging field of Planetary Health in respect to empirical evidence from the Global South.

### **1.3 Objectives**

We hypothesized that climatically vulnerable households and communities have worse child health outcomes and healthcare services. In order to test this hypothesis, we explored the differences in the vulnerability of communities/households situated in different locations in the study region and the corresponding differences in the health and healthcare outcomes and the possible solutions. The specific objectives of this study were:

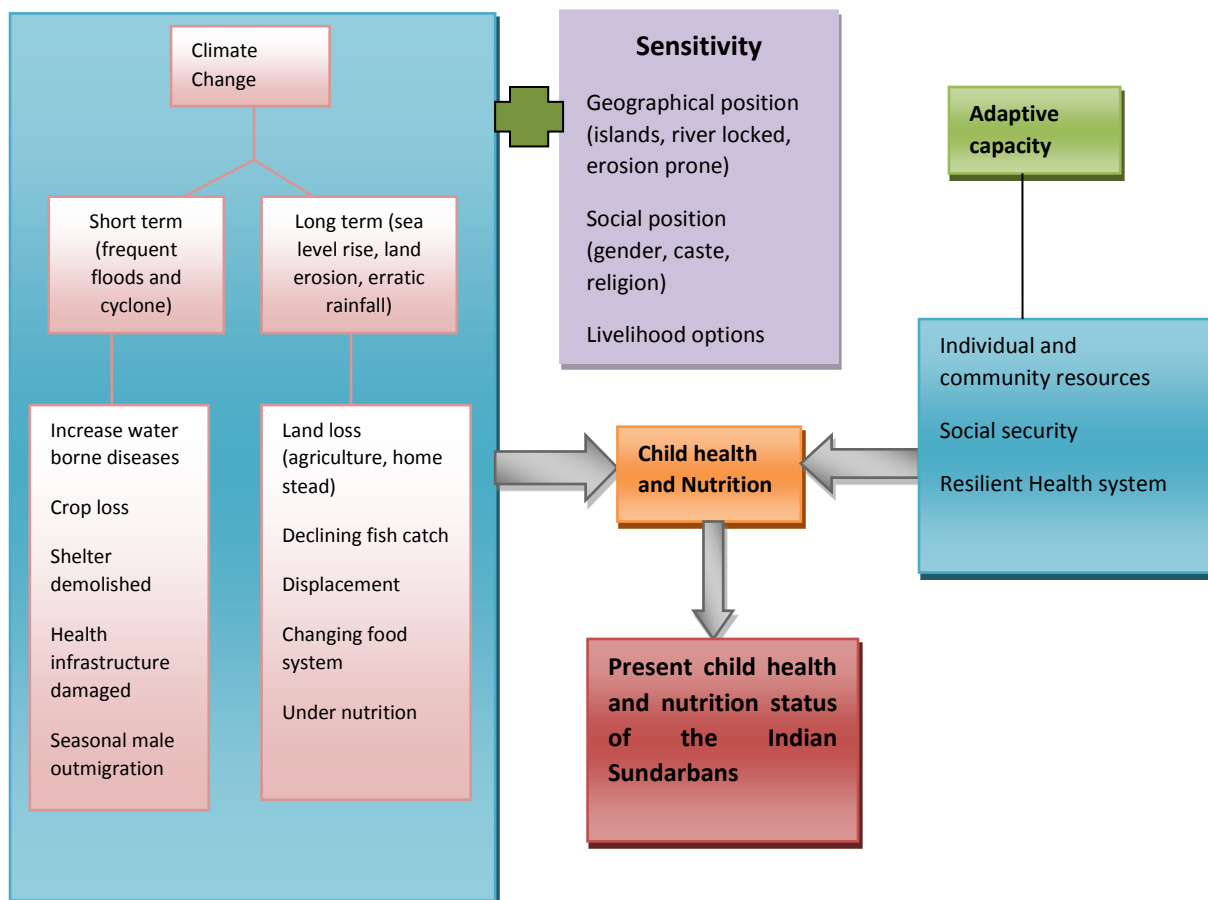
1. To determine the differences in climatic vulnerability between households from three geo-climatic pockets in the study region.
2. To determine if there are any differences in health and nutrition outcomes between households in these pockets.
3. To explore why and how varying levels of climatic vulnerability affect determinants of child health and nutrition.
4. To assess the barriers and challenges to climate resilience faced by the health care delivery system of the Sundarbans.

### **1.4 Conceptual understanding:**

The central concept, on which the report revolves, is differential child health vulnerability at the sub-community level and the factors that shape the differentiated vulnerability amidst climate change. Climatic vulnerability depends on three inter-related factors-exposure (to multiple climatic manifestations like frequency of floods or cyclones, sea level rise, erratic rainfall, salinization etc.); sensitivity (dependence on environment for livelihood, shelter; geographical context; socio-economic status and gender) and adaptive capacity (Socio-economic and physical assets; knowledge, technology and governance related resources; socio-economic power to mobilize resources). Greater exposure to climatic changes does not directly translate into greater vulnerability to reduce household resources and subsequent child health impacts. Vulnerability of the household depends on three aspects: i) the extent of climatic impacts faced by the household, ii) the socio-economic characteristics of the household that make it more sensitive to climatic impacts and iii) the ability of the household to recuperate from the losses incurred due to climate impacts. For example, households that depend primarily on agriculture are more sensitive to food insecurity induced malnutrition than a household that earns its living from a range of occupations. We argue that climate change manifestations are differentially distributed across the Sundarbans and the extent of impacts highly varies as per geographical sensitivity of the region and socio-economic adaptive capacity of the concerned populace (Figure 1). The children living in climatically vulnerable pockets of the Indian Sundarbans

have to face more adverse health impacts than those in other parts of the Sundarbans though exposed to similar climate change manifestations (IPCC, 2015). They face nutritional deficiency due to decrease in food intake as a result of shrinking of parents' livelihood, land erosion and/or salinization. They are burdened with waterborne diseases more than their mainland counterparts, and an unsafe physical environment acts as a detriment to their health and wellbeing. We further argue, socio-economic factors and access to available resources mediate the adaptive capacity of the people to respond to the child health condition in the context (Figure 1). Health care delivery system, one of the crucial factors to boost adaptive capacity, is equally hampered by climate change. The existing health care system is losing infrastructure and human resources and is little prepared to cope with the climatic challenges in terms of knowledge, capacity and governance. Under these circumstances, child health and nutritional status of the Sundarbans are becoming more and more vulnerable with time (Figure 1).

**Figure 1: Conceptual understanding: Climate change vulnerability of child health in the Sundarbans**

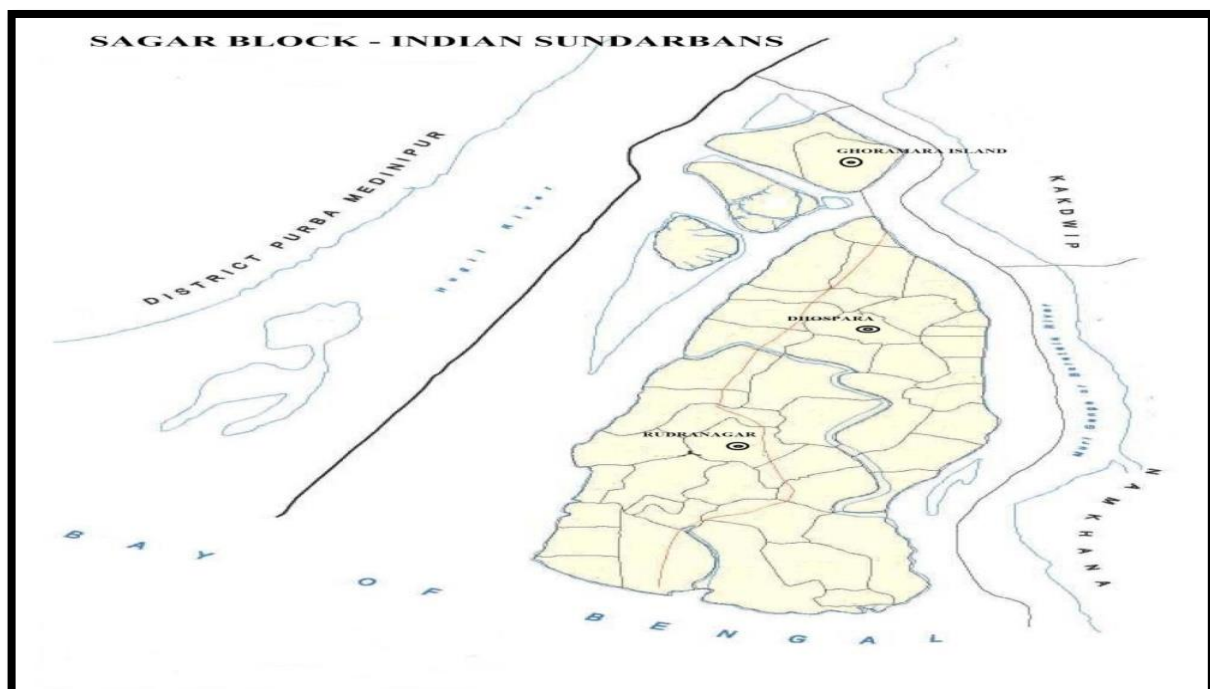


### 1.5 The study:

Central to the aforementioned conceptualization, we conducted a cross-sectional mixed method study in one of the climatically vulnerable blocks of the Indian Sundarbans—the Sagar Island—from April to July, 2016. For the purpose of comparison of differential vulnerability, we used a criteria based sampling to select three villages from Sagar block based on their proximity to the ocean and access to the nearest town. Accordingly, Ghoramara, Dhaspara and Rudranagar villages were selected (figure 2) from the Sagar Island. Ghoramara is representative of the climatically vulnerable coastal islands facing rapid land erosion due to sea level rise, frequent inundation and salinization. Rudranagar represents the stable mainland where the manifestation of climate change is not that visible except in terms of erratic and intense rainfall. Dhaspara being located between the stable mainland and erosion prone coastal zone experiences erosion, flooding and salinization. The part of Dhaspara which is close to the river is eroding rapidly while the other part which is connected to the mainland is more or less stable in nature. These three selected villages represent the unique nature of Sundarbans' geography itself, depicting differential geographic sensitivity to climate change impacts. Three selected villages provide the nuances of the context-specific sub-community level vulnerabilities and their struggle to adapt to the situation. The selection of the villages helps to understand that if there can be differences in exposure, sensitivity and adaptive capacity within a single administrative unit (Sagar Block), it is natural that such differences would take a much larger shape in case of the whole Indian Sundarbans.

**Figure 2: Study villages within the Sagar block**

**Source: census 2011 c.d block maps, Sagar block, south 24 Paraganas, West Bengal, India**





## 1.6 Data and method:

A range of quantitative and qualitative tools and techniques were used to collect data for the study. For conducting the household survey, we used a systematic random sampling for selection of households with children below 6 years of age in each village. Each village was divided into segments based on Anganwadi center<sup>1</sup> catchment area. All households with children below 6 years of age were mapped in each segment. Households were selected sequentially from the list of mapped households from all three villages. A total of 1041 households were surveyed from all the three villages where the head of the household was the respondent. We assessed children's (0-6 years) malnutrition status by using standard anthropometric measurements like height and weight and mid-upper arm circumference. For measuring food security status we used USAID's food security questionnaire. To be specific, the sections of the household survey were as follows- a) malnutrition status of the children, b) childhood illness in the last 30 days, c) access to health and nutrition services, d) status of food security in households, e) migration and its effects on households, f) experience of climate change manifestations and its effect on assets, livelihood and food security and g) utilization of child health services from public health system.

From the household survey data, we calculated vulnerability index and household level vulnerability rank by using variables of exposure, sensitivity and adaptive capacity (IPCC 2009) [for details of the indicators, please see Section 2; sub-section-2.2].

Qualitatively, by using traditional techniques like in-depth and key informant interviews as well as Participatory Rural Appraisal (PRA) techniques, the study tried to explore community's and health system's experiential response towards climatic vulnerability of child health in the Sundarbans. We explored climate related barriers and challenges of availability, accessibility and acceptability of health and nutrition resources by the community through an open-ended, in-depth guide. A total of 18 (six each in three villages) interviews were conducted with the mother or primary care giver of the child purposively selected during household survey. Selection of cases depended upon firsthand experience of child illness or noticeable under nutrition status for which the mother/caregiver had to seek care outside home in the last one year.

We implemented three PRA techniques in each village namely, Climate Shock History, Seasonal Calendar and Food Choice Exercise in order to get a nuanced understanding of the ground realities. Climate Shock History aimed at understanding to what extent the community is facing climate

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<sup>1</sup>Centers that take up nutritional and early development care of children under six years and pregnant mothers under Integrated Child Development Schemes.

extremes; their coping strategies; supports and assistance received during emergencies; damage and loss during emergencies etc. Seasonal Calendar aimed to explore seasonal variations in the community's coping behavior in terms migration, food access, and cash in hand etc. The Food Choice Exercise, on the hand, aimed to understand what people ate over the last seven days and, on the other, why they made such choices. This tool helped to develop a nuanced understanding of food security status of the region. These PRA exercises were conducted with mixed group (gender and age) participants at the centre of each village.

Key Informant Interviews with all the public and private health providers serving in the three study villages were also conducted to understand their perception and response regarding climatic vulnerability of child health. A health services questionnaire was also given to the public health providers to assess the service readiness of the facilities for handling climate related child health burden. A total of 13 formal and informal health providers were interviewed across three selected villages.

### **1.7 Structure of the report:**

The report starts with the situation of climatic vulnerability of the households in three different study villages in order to understand how vulnerabilities vary with exposure, sensitivity and adaptive capacity within a single administrative unit and within 282.11 Km<sup>2</sup> of spatial distance.

The second section of the report describes our analysis and understanding of vulnerability ranks of and its impacts on three villages as well as the surveyed households in terms of exposure, sensitivity and adaptive capacities to understand the background where a child is born grows up and lives.

The third section describes the pathways of linkages between climatic vulnerability, food insecurity, malnutrition and morbidity. The section discusses facts and figures to make explicit the pathways of climate change impacts on child health in the Sundarbans.

Section four discusses responses of the households to the impacts of climatic adversities. The section further discusses how climate change impacts influences health seeking behavior mediating through social factors.

The fifth section is about the present condition and responses of health care systems to climatic adversities in the Sundarbans. The section focuses on challenges and barriers within the system; knowledge of the ground level health workforce, skills and preparedness towards the climate-health linkage.

The report ends with plausible recommendations which can be incorporated in the planning and policy making towards a climate resilient health care system in the Sundarbans.

## **Section 2: Climatic Exposure, Sensitivity and Adaptive Capacity— One Region, Varied Impacts**

### **2.1: Introduction**

The main objective of this section is to explore how climate change manifestations impact the physical, social and economic environment of the children. The damage to the environmental and physical infrastructure in turn affects the livelihood, health and wellbeing of the population. As mentioned earlier, we measured climatic vulnerability as a product of the experiences of climate exposure, degree of sensitivity of the households towards the exposure and resultant impacts; and their current adaptive capacity.

Inhabitants of the Sundarbans delta face climate-related vulnerabilities that operate across different temporal and geographical scales. In a long-term perspective, the delta is and has always been in flux: in terms of changing currents and their confluence, the erosion of existing lands and the formation of new ones, and associated consequences for sea level, water temperatures and salinity. However, the rate of change has increased in recent decades, according to some studies; acceleration possibly connected to anthropogenic emissions of greenhouse gasses (Mitra et al 2009; Hazra et al 2010). From a more immediate perspective, the area is exposed to major natural shocks such as cyclones, floods, and tsunamis. These varying temporal dynamics entail vulnerabilities, and possible adaptive responses, with a wide range of physical and social implications. In terms of geography, vulnerability shifts in nature and severity as one move from the mainland towards the outer islands. Moreover, some sources of vulnerability may operate on a scale that affects whole communities while others may vary across households or individuals.

Conventionally, vulnerability assessments are spatial in focus and presentation. Vulnerability is divided into broad categories – in the simplest articulations, into natural and human vulnerability – and relevant quantitative indicators are selected as particular expressions of vulnerability in a given category (Sherly et al 2015). For example, elevation, building material, and age of structure could be indicators of vulnerability to the natural hazard represented by a flood. For each indicator, vulnerability is measured as relative rather than absolute, normalized according to minimum and maximum values. Here, in line with the project's emphasis on differential vulnerability, we proposed an assessment of vulnerabilities in the Sundarbans delta that captures vulnerability at the household level. In particular, we wanted to understand the manner in which exposure to natural and social sources of vulnerability, although normally associated with higher levels of resolution, impact households differentially, and build their adaptive capacity.

## 2.2 Measuring differential vulnerability of three selected regions

The study used the following parameters and indicators to measure vulnerability of a household as well as of a village:

**Exposure** refers to experiences of extreme climatic events and shocks that can impact the livelihood and shelter of the households in the communities.

**Sensitivity** is the degree to which the community or household is affected by climatic stresses.

**Adaptive Capacity** is the ability of a system to adjust to climate change (including climate variability and extremes) and moderate potential damages, as well as to take advantage of opportunities, or to cope with the consequences.

**Vulnerability** is defined as the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes.

We then calculated the index for climatic vulnerability of households by using standardized variables representative of the degree of climatic exposure, sensitivity towards climatic extremities and adaptive capacity of the households. Principal component analysis was done on variables for sensitivity and adaptive capacity separately and the principal component that accounted for maximum variance was used as index for both these indicators. We used the following variables for the purpose of the calculation (table 1):

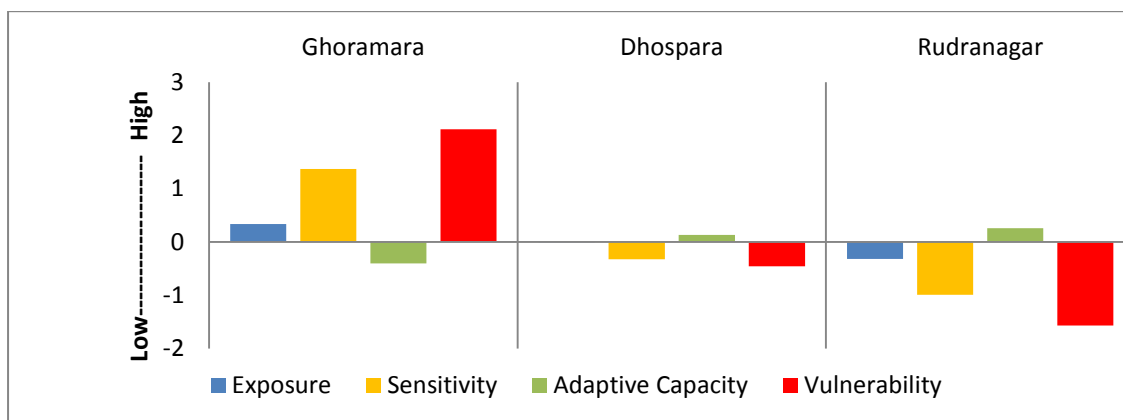
**Table 1: Indicators for Vulnerability Index**

Exposure	<ul style="list-style-type: none"><li>• Frequency and Intensity of climatic extremities in the last 5 years</li></ul>
Sensitivity	<ul style="list-style-type: none"><li>• Damage to HH assets due to climatic shock</li><li>• Dependence on agriculture for food</li><li>• Dependence on agrarian occupations</li><li>• Health</li><li>• Physical Accessibility</li></ul>
Adaptive Capacity	<ul style="list-style-type: none"><li>• Financial Capital – Ownership of assets, Income, Livelihood Diversification, Food security</li><li>• Human Capital - Education of the HH head and adult members of the household</li></ul>

	<ul style="list-style-type: none"> <li>• Social Capital - Membership in Community Based Organizations</li> </ul>
Vulnerability	Exposure + Sensitivity - Adaptive Capacity

The vulnerability index reflects that exposure to recurrent climatic adversities is highest in Ghoramara islands and lowest in Rudranagar, and there are clear differences in the degree to which these regions are sensitive and equipped to adapt with climatic adversities (Figure 3). The sensitivity of households in these three regions followed a predictable pattern. Households in Ghoramara were found to be highly sensitive due to repeated onslaught of climatic shocks and land erosion, and exhibited low degree of adaptive capacity. Rudranagar, owing to its peri-urban characteristics, accessibility and infrastructure, ranked high in terms of adaptive capacity and consistently low in sensitivity to climatic events. However, Dhaspara did not show a similar pattern even though it is close to the block headquarters of Rudranagar. It was seen to be relatively more vulnerable than Rudranagar and recorded low degrees of adaptive capacity (figure 3).

**Figure 3: Climatic exposure, sensitivity, adaptive capacity and vulnerability by region**



### 2.3 Extent of regional and household level vulnerability:

Evidence showed that gradual impacts of climate change in these regions are different in extent and character. In Ghoramara, the impacts are rapid and striking as almost each year, especially after Aila in 2009, the people have had to face cyclone, flood or inundations often leading to erosion. During the exercise 'Climate Shock History', participants were asked to describe their experiences of extreme climatic events after Aila in 2009. The point of counting the shock history after Aila was to explore the extreme events which did not receive as much focus as Aila but still became a part of people's daily existence. **Table 2** describes the frequency and intensity of the extreme events that the people of Ghoramara, Dhaspara and Rudranagar had to face in the last five years (2010-2015).

The exercise showed that 2013 was the only year in which Ghoramara had not faced any major climatic shock while in all the other years there were inundations due to raised water level, severe flooding and cyclonic events. The impacts varied from breaching of embankments and related inundation, demolition of homestead, loss of productivity of agricultural land and fishing ponds, scarcity of potable water and moderate to severe health hazards like diarrheal diseases, skin rashes and general cold and cough. Dhaspara also faced similar kind of climatic hazards, though much less in frequency and intensity both in terms of damage and destruction. On the other hand Rudranagar did not face any such events in the 5 years after Aila happened in 2009 (table 2).

**Table 2: Climate shock history of Ghoramara, Dhaspara and Rudranagar for the last five years**

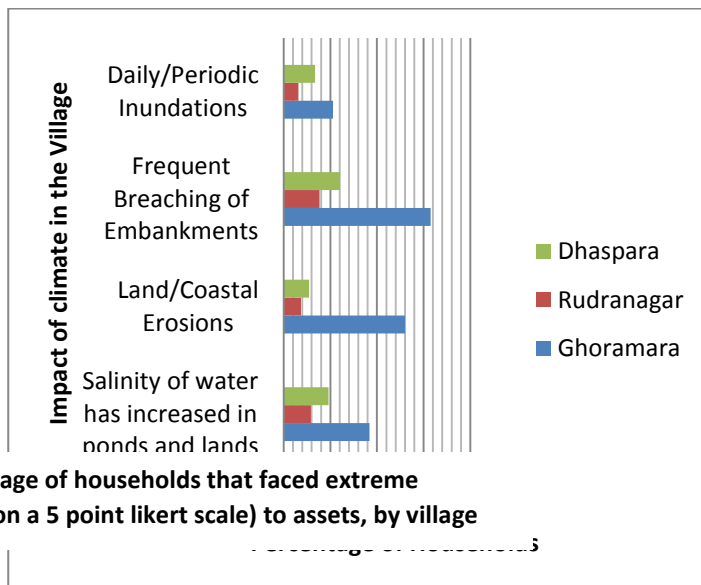
Year				
2015		Ghoramara	Dhaspara	Rudranagar
	Type of Extreme Event	Water level increase	Heavy rainfall	None
	Type of Destruction	Breaching of embankment and Inundation started	<ul style="list-style-type: none"> <li>• Water logging</li> <li>• Destruction of mud houses</li> <li>• Crop loss</li> <li>• Wage loss</li> </ul>	None
2014	Type of Extreme Event	Moderate cyclone	Mild cyclone	Heavy rainfall
	Type of Destruction	<ul style="list-style-type: none"> <li>• Inundation due to embankment breaching</li> <li>• Demolition of homestead</li> <li>• Severe skin infection</li> <li>• Huge agro-product loss</li> <li>• Loss of fishing</li> <li>• Loss of cattle</li> <li>• Drinking water crisis due to salinity intrusion</li> </ul>	<ul style="list-style-type: none"> <li>• Loss in betel leaf cultivation</li> </ul>	Moderate crop loss
2013	Type of Extreme Event	None	Inundation due to embankment breaching	None

	Type of Destruction	None	<ul style="list-style-type: none"> <li>• Water logging</li> <li>• Loss of agro-products</li> </ul>	None
2012	Type of Extreme Event	Cyclone of low intensity (Hudhud)	None	None
	Type of Destruction	No such destruction happened	None	None
2011	Type of Extreme Event	Severe flooding	None	None
	Type of Destruction	<ul style="list-style-type: none"> <li>• Huge loss of land</li> <li>• Households demolished</li> <li>• Livestock washed away</li> <li>• Children suffered from fever and diarrhea for almost a month</li> <li>• Loss of agro-product and fish catch</li> </ul>	None	None
2010	Type of Extreme Event	Inundation due to embankment breaching	None	None
	Type of Destruction	<ul style="list-style-type: none"> <li>• Water logging in household for months</li> <li>• Loss of pond fishing due to salinity intrusion</li> <li>• Loss of agro-products due to salinity intrusion</li> </ul>	None	None

Household level analysis of climatic vulnerability provided a more layered understanding of how exposure, sensitivity and adaptive capacity work at the sub-community level, irrespective of their selected regional positions. More than 90% of the 1041 surveyed households faced considerable climatic exposure mainly in terms of flood and cyclone at least once in the last 5 years. In terms of perceived severity, 66.6% of the households in Ghoramara reported facing severe climatic events compared to 44.1% in Dhaspara and 36.3% in Rudranagar. According to the survey respondents, repeated climatic adversities led to increased salinity of ponds and estuaries, coastal erosions, frequent embankment breaching and related inundations. As impacts, households reported loss of

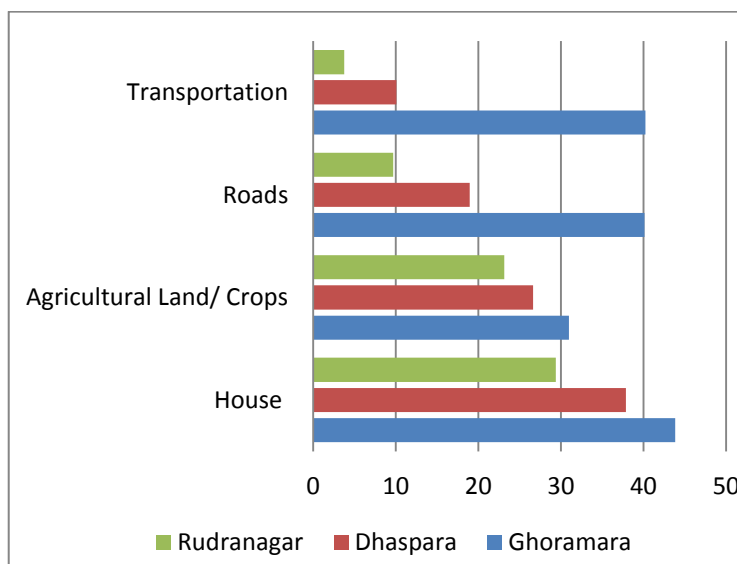
homestead, assets, property, crops, agricultural lands and sweet water ponds and increased salinity in agricultural land and pond water. Reports on breaching of embankments and land erosion were highest in Ghoramara Island (Figure 4).

**Figure 4: Percentage of households reporting effects of climatic adversities by study locations**



Effects like rising salinity of the land and ponds, and embankment breaching were also reported by households from Dhaspara. 19.2% of these households reported a rise in salinity levels while 24.2% said there was frequent breaching of embankments in the region. Households of Rudranagar, however, faced less damage compared to the other two regions.

**Figure 5: Percentage of households that faced extreme damages (rated on a 5 point likert scale) to assets, by village**



To measure sensitivity, the head of each household was asked to rate the damage incurred on household and community assets on a 5 point Likert scale. The greatest loss was reported for houses, land and crops followed by community assets like roads and transportation. Figure 5 shows the percentage distribution of households that faced extreme losses to household and community assets.

Clearly, a higher percentage of households in the sea facing region of Ghoramara faced losses to household infrastructure, roads, transportation and land compared to others, followed by Dhaspara and Rudranagar. Evidence suggests sensitive geographical position, both in case of a region or a household, plays a key role in determining its climatic vulnerabilities.

## 2.4 Adaptive capacity

Even though extreme exposure to climatic adversities and high sensitivity can destroy the physical and economic resources of a region, it is the ability of the households and the community to cope with the



loss that determines the extent of climatic impact. Our interaction with communities from the three regions within Sagar block revealed interesting glimpses of people’s long term and short term strategies to deal with climatic vulnerabilities.

#### 2.4.1 Strategies to handle immediate impacts

Households face a range of economic and physical hardships every time there is a sudden climatic shock. They cope with these losses mostly using existing financial resources and assets. In most cases, they expend their savings or sell household assets like land, poultry and animals to repair their homes. This ‘quick-fix’ strategy pushes poor families to further impoverishment. Along with relying on existing financial resources, households also borrow money from money lenders and extended family at interest rates usually higher than the market rate. They have to pay the debt on time either in cash or in kind (mostly in the form of agricultural products). Providing free labour in the field of the money lender during the agricultural season to repay debt is also a common practice. These hardships place considerable burden on families and hinder the securing of a continuous income for sustenance and also to deal with future shocks of similar kind. Table 3 reflects the coping strategies adopted by the people of the three studied regions during climatic emergencies in the last five years. During the mixed group PRA exercise-Climate Shock History, people narrated their first hand experiences while handling the shocks along with the external support they received during the emergencies.

**Table 3: Climatic events, coping strategies and support – getting by the people handling climatic shocks in the last years**

Year				
2015		<b>Ghoramara</b>	<b>Dhaspara</b>	<b>Rudranagar</b>
	Coping strategies	Villagers hold up the embankment with bare hands to repair the cracks with mud before high tide	Borrowing from micro-finance group to rebuild the houses	None
	Institutional Support	None	<ul style="list-style-type: none"> <li>• Govt. provided compensation for crop loss</li> <li>• List prepared to provide compensation for</li> </ul>	

			homestead destruction	
2014	Coping strategies	<ul style="list-style-type: none"> <li>• Stayed on the boat or embankment for two to three months</li> <li>• Built houses with paper and plastic</li> <li>• Borrowed money from money lenders to rebuild homes</li> <li>• Male migration to sustain the family</li> </ul>	Borrowing money from local money lenders	No strategies taken by the people
	Institutional Support	<ul style="list-style-type: none"> <li>• Panchayat provided tarpaulin</li> <li>• ORS and halogen tablet distributed from Sub centre</li> </ul>	<ul style="list-style-type: none"> <li>• Compensation provided by the Govt.</li> </ul>	Compensation provided by the Govt.
2013	Coping strategies	None	<ul style="list-style-type: none"> <li>• Have to spend assets like savings</li> <li>• Borrowing money from local money lender</li> <li>• Spent 20 days in School building</li> </ul>	None
	Institutional Support	None	<ul style="list-style-type: none"> <li>• Panchayat provided tarpaulin and dry food</li> </ul>	None
2012	Coping strategies	No such strategies taken by the people	None	None
	Institutional Support	<ul style="list-style-type: none"> <li>• Planned evacuation done by Government</li> </ul>	None	None

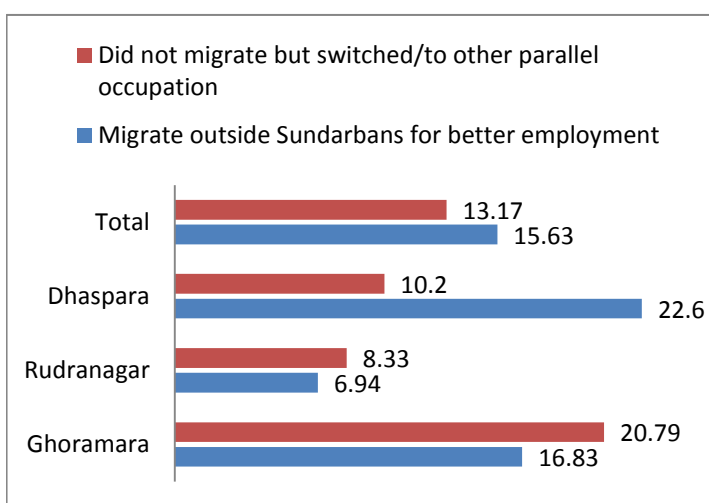
		<ul style="list-style-type: none"> <li>• Rice flakes given by Panchayat</li> </ul>		
2011	Coping strategies	<ul style="list-style-type: none"> <li>• Stayed 3 to 4 months on the embankments or in boats</li> <li>• Sold cattle for ready cash</li> <li>• Built up the embankment in a new location No migration because people were engaged in embankment building work</li> </ul>	None	None
	Institutional Support	<ul style="list-style-type: none"> <li>• No relief</li> </ul>	None	None
2010	Coping strategies	<ul style="list-style-type: none"> <li>• Sold assets</li> <li>• Male migration in search of livelihood</li> </ul>	None	None
	Institutional Support	<ul style="list-style-type: none"> <li>• No relief</li> </ul>	None	None

### 2.4.2 Strategies to handle long term impacts:

Long term manifestations of climate change like periodic inundation due to embankment breaching, erratic rainfall, erosion and increase in salinity of land and sweet water resources have direct impact on the agro-fishing economy of the Sundarbans. This has led to a shortage in economic opportunities for families. Consequently, families have had to look for multiple ways of securing income and resources.

Seasonal migration and livelihood diversification were found to be two of the most important strategies of the households from deltaic regions like Dhaspara and Ghoramara for dealing with climate change impacts on livelihood. Households not only seasonally migrated to other locations for new occupations; they also resorted to more than one source of income at a time. Dependence on a single agrarian or fishing source can be extremely detrimental especially for families living in regions like Ghoramara.

**Figure 6: Migration and Household's livelihood adaptation**



As a part of our study we asked heads of the households to list the impact of climatic adversities on livelihoods. The results show that out of 1041 households interviewed, 86.07% said that climatic extremities affected their livelihood. 15.63% of the respondents stated that the primary bread-earner migrated to another location while 13.17% reported a shift to other occupations within the same region. Across the three study sites, 21.22% of the households reported having at least one member who had migrated in the last five years. The percentage of families with at least one migrated member was highest in Dhaspara [32.84%] followed by Ghoramara [17.35%] and Rudranagar [13.72%].

### 2.5. Conclusion:

The evidence presented above reflects the eco-social background where a child of Sundarbans spends its childhood. Findings revealed that exposure to climatic adversities is more or less equally distributed over the Sundarbans region as almost all the studied villages have experienced medium to high climatic shocks at least more than once in the last five years. The sensitivity to these exposures, on the other hand, depends on geographical location of the households; the intensity of sudden and slow damages they are suffering; and options for livelihood diversification. In this regard the island pockets

of the Sundarbans fall behind their mainland counterparts to become highly vulnerable to the impacts of the frequent climate extremes.

Hence, adaptive capacities of the households play a significant role in dealing with such climatic adversities. People are trying their best with short term alternatives and male out-migration is the most noteworthy among them. Communities are also trying to shift their livelihood patterns by joining the marginal workforce, a clear trend reflected from the findings and also from the data of two consecutive censuses (2001 and 2011). Lack of vibrancy in the alternative livelihoods options within Sundarbans is compelling youths to migrate out of the island. Due to the differential vulnerabilities, strategies taken by the community also vary accordingly. Hence, the strategies people take in Rudranagar may not be suitable for the people of Dhaspara, despite geographical proximity.

## **Section3: Impacts of Climatic Vulnerability on Child Health**

### **3.1 Introduction**

*“Don’t ask a starving mass what hunger is. Let us deal with the uncertainty of life first, the rest we can take care of. In my childhood I have seen my grandfather owning 10 acres of land. In my young days I used to grow vegetables on my land for own consumption as well as for sale outside Ghoramara. Five years ago all my land was washed away. I somehow manage with the homestead. Ghoramara was once famous for producing vegetables. Now, nothing goes out from Ghoramara. Instead, vegetables come from Kakdwip twice a week. We have to buy those vegetables at a high price or just survive on salt and rice.”*

- A 65-year-old farmer of Ghoramara who had lost his agricultural land due to coastal erosion

Such stories are common narratives across the Indian Sundarbans and one can easily presume the underlying stress that the community is facing in the region. Circumstances seem to have a severe impact on the health of the island’s children. A longitudinal time series study would help in better understanding of the impact extent. However, with a cross sectional design, we tried to establish pathways linkages of climate impacts on child health. This chapter exhibits evidence on linkage between climatic vulnerability and child health status. The study took three significant indicators- household level food insecurity, malnutrition status and frequency of illness of the children with water borne diseases- to establish linkages between climatic vulnerability and child health status.

### **3.2 Malnutrition increases with increase in climatic vulnerability**

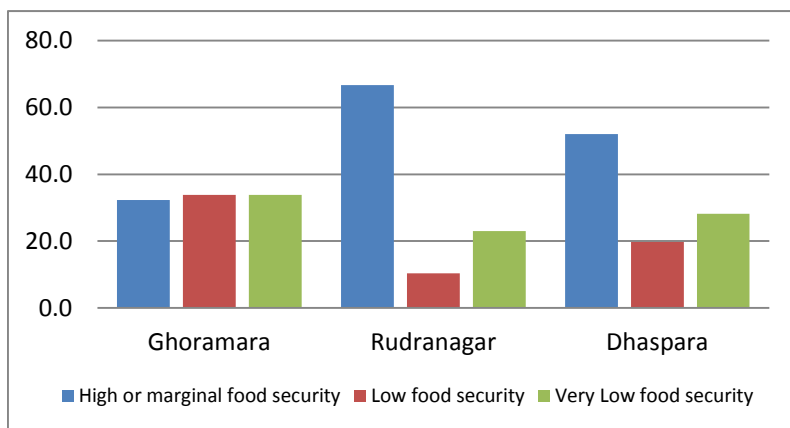
Children’s nutritional outcomes in the three regions show clear differentials. The burden of child malnutrition is lowest in Rudranagar as compared to the deltaic and semi-deltaic regions of Ghoramara and Dhaspara, respectively. Prevalence of short term malnutrition like underweight children is almost 10 percentage points lower in non-deltaic Rudranagar. If we compare children of different ages, income groups and gender, we see that burden is expectedly higher among children from households of low socio-economic status, which coincides with most of the backward districts of West Bengal. Prevalence of moderate to severe underweight (41.2 percent) and stunting (35.7 percent) was highest in the age groups of 24 to 36 months. The burden of severe malnutrition seems to be more on the older children living in these regions.

#### **3.2.1 Climate induced food insecurity affects child diet**

A positive co-related nexus has been observed between the pattern of food insecurity, child malnutrition and household’s climatic vulnerability status. The findings reconfirming the established vulnerability cycle worldwide. It suggests that households that face recurrent climatic shock and have

high sensitivity to the same but low capacity to adapt to and recuperate from the losses are at a higher risk of food insecurity. Many households in the region have to now depend on multiple sources of income that are non-agricultural in nature. Food used for daily consumption is mainly obtained either through government rations or purchase rather than own production. Discussions with the community showed that households face loss of food resources during climatic emergencies. Across the three regions, 25.4% of the households were seen to have faced extremely high loss of food during climatic

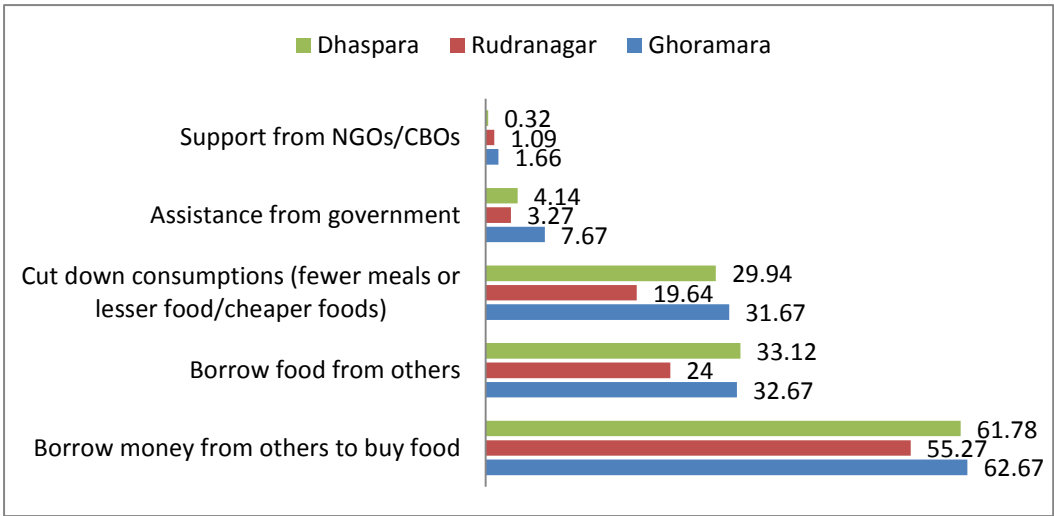
**Figure 7: Household food security status by region (N= 1041)**



emergencies in the last 5 years. In Ghoramara, 34.4% of the households faced extreme damage to food resources while this percentage was 23.4% and 17.8% in Dhaspara and Rudranagar, respectively. The data also revealed that household level food insecurity was positively co-

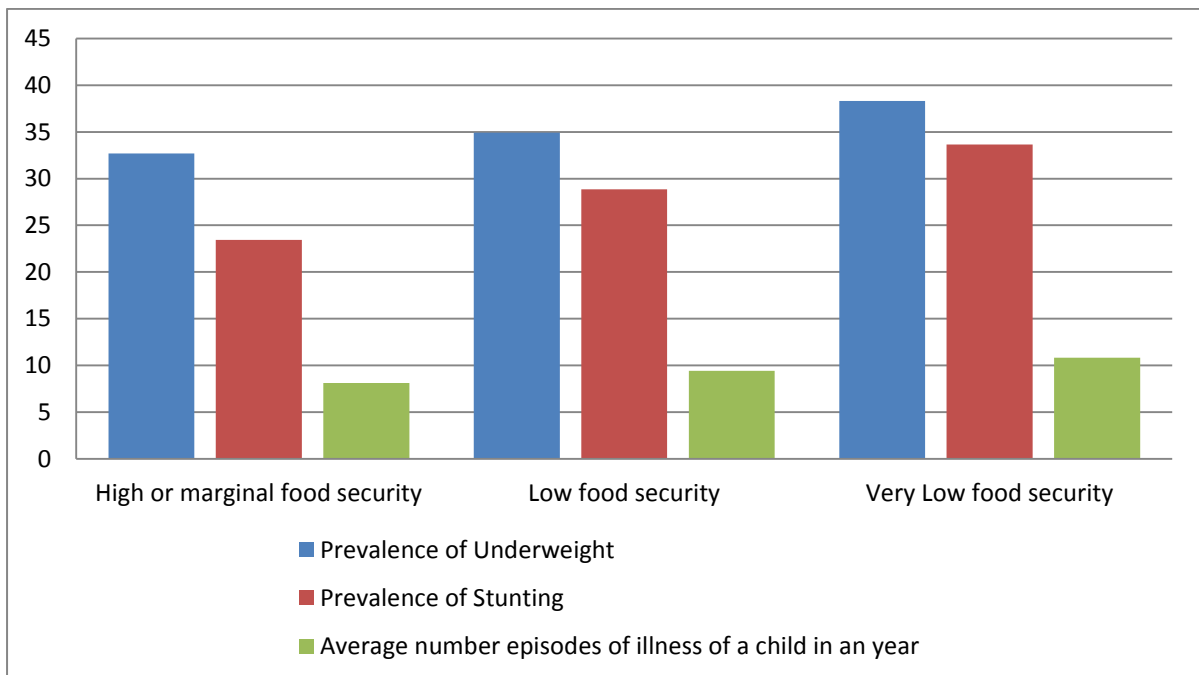
related with climatic vulnerability of the households. Ghoramara had a higher percentage (32.00%) of households that are food insecure, compared to Rudranagar (21.00%) and Dhaspara (28.00%) [Figure7].The percentage of households with adequate access to food in the last 12 months was highest in Rudranagar and lowest in Ghoramara. Households opted for many methods to cope with the food insecurity. Very few households were seen to depend on the assistance received from the government or non-state actors like NGOs/ CBOs. Many households borrowed money or food directly from vendors for consumption. Cutting down meal consumption and switching to cheaper foods were also common strategies to cope with this loss of food (Figure 8).

**Figure 8: Coping strategies to deal with food insecurity**



Further analysis shows a direct linkage of malnutrition status and average number of child illness in a year, along with the household food security status (figure 9). The prevalence of child malnutrition and average number of child illness was higher in households facing very low or low food security (figure 9). These figures point strongly at the association between climate-induced food insecurities and malnutrition and morbidity pattern of the children of the climatically vulnerable households.

**Figure 9: Child malnutrition, morbidity pattern and household food security (%)**





### 3.2.2: Limitation in choices of food:

Like the quantity of the household food consumption, climatic vulnerability also impacts the choices of food of the community. During the Participatory Rural Appraisal- Food Choice Exercise, participants were asked to how many days in a week they consumed the following food groups: 1) Rice / Wheat 2) Potato/Tuber 3) Pulses 4) Fish/Meat 5) Oil/Fat 6) Egg`7) Dairy 8) Vegetables 9) Fruits 10) Sugar/Sweets. Analysis shows (table 4) that households of Ghoramara missed out on crucial food groups like dairy, oil/fats, fruit and sweets/sugar. ***“Frequent embankment breaching, flooding and salinity intrusion damage the agricultural products to a great extent, which eventually impacts the food production. This brings changes in the market too.”***- stated by a 37-year-old male respondent from Ghoramara.

***“The island once known for its vegetable cultivation now has to depend upon the market to buy vegetables and fruits for daily consumption”***-stated by another 41-year-old male respondent from Ghoramara during the PRA. Respondents also expressed similar concern in case of fishing. Like the agricultural land the sweet water ponds within the islands also get saline due to frequent inundation resulting in depletion of fish catch. According to the respondents, they now have to depend on the market to buy fish and this market is operated by Kakdwip- (Block town to be reached by crossing the river) based businessmen. Respondents agreed that as the expenses of daily consumption increase, they often cut food groups like oil/fat, sweets/sugar and fruits from their daily meal and keep the meal restricted to rice, pulses and locally available vegetables like potato. According to the respondents, sometimes rice and pulses are also inadequate to feed the entire family for a whole week, a factor which has increased their dependence on the public distribution system. During discussion community members stated that they first secured the food for children, at least the basic like rice and *dal* (pulses).

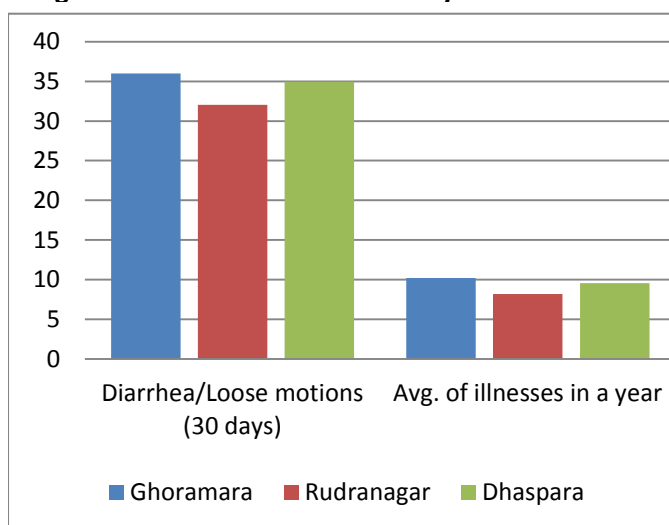
***“We usually skip meals at least once a day whenever we sense a shortfall for the children”***. -stated by 32-year-old female respondent of Ghoramara. Dhaspara, too, is marked by a declining productivity of land and pond water, though not as rapidly as Ghoramara, and exhibited changes in the food consumption pattern. Rudranagar stood out in this respect, having not yet seen any decline in agriculture and fishing and thus featuring inclusion of all food groups in household diet.

### 3.3 Morbidity among children highest in climatically vulnerable regions

Like malnutrition, morbidity status of the children also showed clear differentials between the three regions as per their climatic vulnerability. We asked mothers of children to report the number of episodes of illness in a year (figure 10). A child was seen to fall sick on an average of 8 times a year, across the three regions. This figure is highest in Ghoramara (10 times a year) followed by Dhaspara. Children in the age group of 25 to 36 months fall sick maximum number of times in a year. If we compare children of the three regions belonging to the same age group, we see that the burden of morbidity is highest in Ghoramara followed by Dhaspara and then Rudranagar. We also asked the mother if the child suffered from diarrhoea in the last 30 days prior to the survey. Even here, the burden is comparatively higher in Ghoramara (figure 10).

In order to understand how much parents of Sundarbans children can link their children's illness with climate, we conducted PRA technique- seasonal calendar and in-depth discussion with parents in the study regions. The community perceived diarrhoea, cough and cold as the most common ailments from which their children suffered most of the time in a year. During the exercise parents were asked to

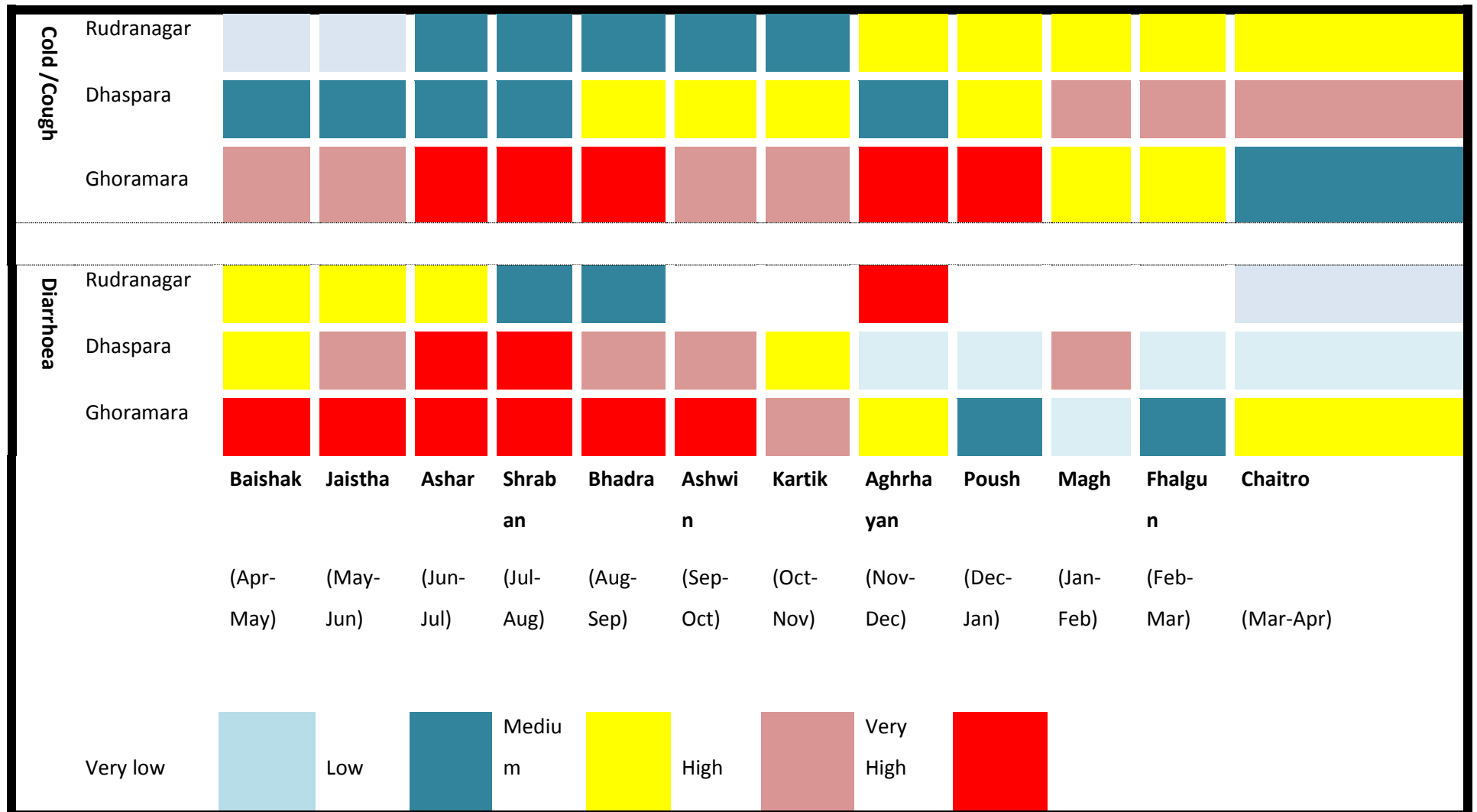
**Figure 10: Prevalence of Morbidity**



rank from 1-5 points (where 5 is the highest and 1 the lowest) the seasons according to the prevalence of the ailments. Parents of Ghoramara ranked diarrhoea highest point (4-5) almost throughout the year (table 4). Cough-cold is also not lagging much behind as per the perception of the parents. It scores almost 3-4 all through the year. Parents of Dhaspara however gave a moderate score to diarrhoea. Interestingly, however, the perceptions were not much in line with

the survey data on the incidents of diarrhoea and cough-cold. People of Ghoramara put more emphasis on the severity of the incidence of the ailments than their mainland counterparts. Discussion with the people revealed their phobic state of mind due to frequent inundation and water logging and related water borne diseases.

**Table 5: Parents' perception of incidence of child ailments as per seasonality**



### 3.4 Conclusion

Findings revealed linkage between malnutrition statuses of the children of the studied regions with the household food security, which in turn was co-related with climatic vulnerability. A similar co-relation was also seen between the numbers of illnesses experienced by children in a year and households' climatic vulnerability. Islands like Ghoramara, which are high in climatic vulnerability, have to face the maximum impact. A typical child of Ghoramara falls sick more often in a year with climate sensitive diseases. In addition, under-nutrition and recurrent morbidity cause the children of the Sundarbans to lag behind in the developmental parameters.

Part of the Sundarbans is facing food resource crunch due to loss of agricultural and fishing products as a result of frequent salinity ingress and rapid land erosion. The consequent change in the traditional agro-fishing livelihood is breaking the economic backbone of the community and increasing social vulnerability, which in turn is increasing the hunger risk among the children of the island. However, the risk is still not well reflected in the malnutrition status of the children due to a range of short term coping strategies taken by the parents. The existing general plans for securing food to the children of the islands like Ghoramara and Dhaspara may not be sufficient to reduce hunger risk and their subsequent illness. The situation calls for identifying climate change as a hindering factor for the healthy growth of the children of Sundarbans. Though the impacts are highly differential and depend upon socio-geographical factors also, still not only Ghoramara but regions like Dhaspara also need considerable attention where malnutrition, recurrent morbidity and risk of hunger are making rapid inroads.

## Section 4: Health care system's challenges, preparedness and responsiveness to climatic vulnerability of child health

### 4.1 Introduction:

Amidst the aforementioned climatic vulnerabilities of the health of the Sundarbans children, it is essential that there is a functional health care system that provides basic preventive and curative services. It is apparent from the study that children in climatically vulnerable regions do not have a safe and resilient local or household environment to maintain good health. This phenomenon is reasonably similar to other climatically vulnerable regions worldwide. Health care delivery system is an important third along with the household/caregiver and the community of the child to promote healthy development of the children. Therefore, improving and strengthening health system in climatically vulnerable contexts have gained significant attention from health organizations globally. According to World Health Organizations it is essential that healthcare delivery systems have the 'wholesome ability and alertness to change and be flexible according to circumstances. It should also continue to function under stress, while enduring changes' (WHO, 2015). According to WHO health system's resilience cannot be merely understood by the absence of vulnerability but it is about the capacity of the whole system. They define resilience as:

**Resilience=Decreasing Vulnerability+ increased capacity, improved choices and opportunities** (WHO, 2015)

In case of public health system, resilience is synonymous to the ability of the system to withstand shocks given by the external forces (be it climatic or socio-economic) and manage health of the community by maintaining basic structure and essential functions of the system (WHO 2015). However, health system's overall performances depends upon the resilience and ability to cope of its building blocks like leadership and governance, health workforce, health information systems, essential medical products and technologies, service delivery and financing. The Climate Resilient Health System framework provided by WHO in 2015, postulates that the state of resilience depends upon the magnitude of climate-induced changes or shocks along with the ability to cope and resume functioning of the system. The framework categorized the extent of resilient into five stages. According to the framework a health system may bounce back as per the changes in five different ways-1) transform 2) recover better than before 3) recover to pre-event state 4) recover but worse than before 5) collapse.

## **4.2: Incorporating climate in the health planning of South-Asian Countries-experiences from neighboring countries**

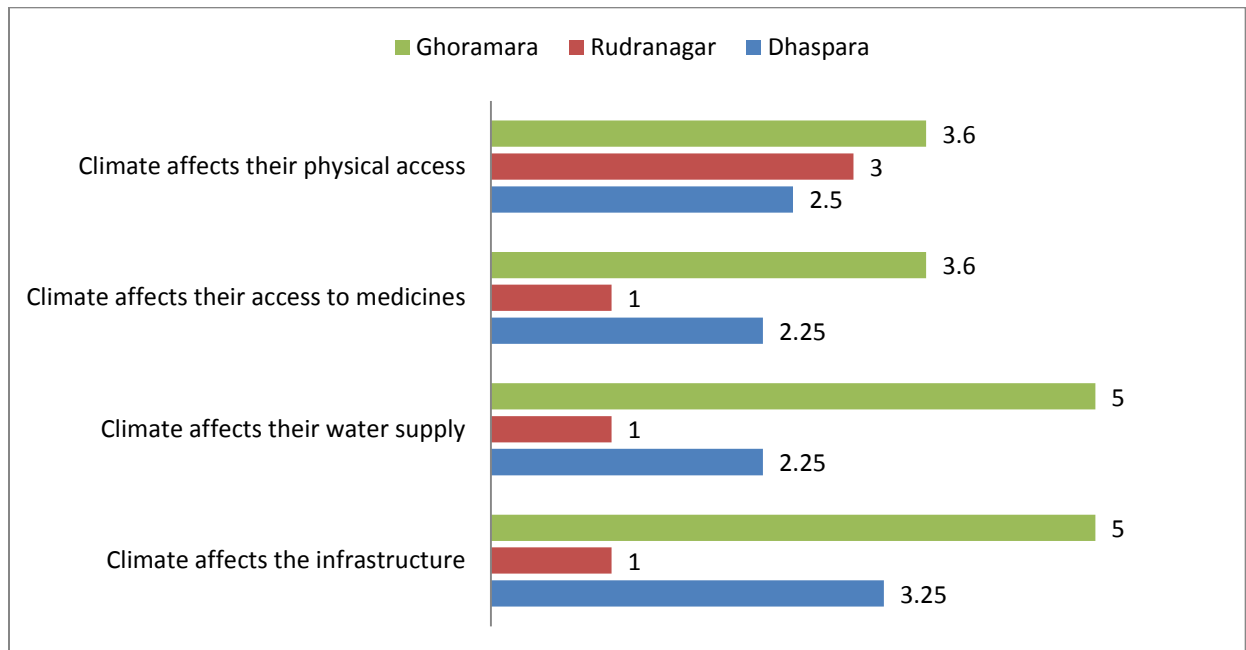
South-Asian countries like India, Nepal, Bangladesh, Pakistan, Myanmar, Maldives, Bhutan, Sri Lanka are facing significant climatic challenges in terms of intense flooding, increasing cyclones, sea level rise and heat waves in recent times which have severe health outcomes. Many South-Asian countries are now incorporating climatic vulnerabilities in their health actions plan or vice-versa while keeping in mind the regions' increasing exposure towards climatic adversities and its impact on human health (Sen et.al, 2018). For example, Nepal has incorporated health prevention measures in its Local Adaptation Plans for Action framework to increase health-climate co-benefits. The plans have incorporated climate-health issues in training of health professional as well as in the course curriculum of colleges and Universities. The health ministry of Nepal is now planning to build the capacity of the Nation's health system as per the WHO guideline of Climate Resilient Framework (WHO, 2015). Sri Lanka, too, is incorporating climate sensitivity of health and nutrition into the planning of the health and nutrition department as well as in the training curriculum of the public health staffs. Countries like Bhutan, Maldives, Bangladesh and Pakistan have identified climate as a significant stressor of health impacts, however, there is little incorporation of climate sensitivity in the health policy planning in these countries (Sen et.al, 2017).

India, most recently has launched National Action Plan on Climate Change and Health under the Mission on Health drafted by the Ministry of Health and Family Welfare. The action plan has developed to fulfill the objectives like 1) generating awareness regarding the climate change and health linkage among the mass, health care providers and policy makers 2) building capacity of the existing health system to respond towards the climate sensitive diseases 3) mapping of national, state, district and sub-district level vulnerabilities due to climatic adversities 4) strengthening stakeholder base with private actors working in the similar field 5) strengthening monitoring, surveillance and research capacities on climate and health. The main emphasis of these entire existing is to reduce the impact of climatic adversities on community health. The National Action Plan for Climate Change has its State level counterparts i.e., State Action Plan for Climate Change (SAPCC). The SAPCC for the State of West Bengal has identified Indian Sundarbans as a climate change hotspot and a designated post has been created in the Ministry of Health and Family Welfare to take care of the climate change impacts on human health. The case of Indian Sundarbans provides the opportunity as a situational template to adopt WHO's Climate Resilient Framework. For that, one needs to comprehend the knowledge, challenges and preparedness of the existing system to find out the ways by which it can be made climate resilient.

### **4.3 Climatic vulnerabilities of health and nutritional care facilities**

In our report we mainly focused on the Integrated Child Development Centres, popularly known as Anganwadi (courtyard) centres. These centres have been designed and implemented to provide basic nutrition and health services to the young children (0-6 years) and pregnant mothers. Write about ICDS supplementary nutrition programme. The centres are also responsible for the initial cognitive development of the children by providing pre-school education. The services provided by the centres make them an essential component for a healthy development of the children. The study revealed that almost all the Anganwadi Centres in Ghoramara and Dhaspara are facing severe damage due to the climatic adversities. There are 10 Anganwadi centers located in Ghoramara, 9 in Dhaspara, and 13 in Rudranagar respectively. In terms of coverage the performance of integrated child development centres is satisfactory with at least one centre for a population of 557, which is slightly higher than the set limit of 1 AWC for every 300 population. However, the geo-climatically vulnerable locations of these centres poses challenges on quality service delivery mechanism amidst constant climatic threats like cyclone, flood and periodic inundations. Discussions with Anganwadi workers open up that most of these centres, despite being located under concrete constructions (*pakka* houses) or made up of non-durable materials (straw, bamboo or mud build), had no contingency planning to handle climatic emergencies. Situation aggravates during the monsoon months especially in the low-lying coastal peripheries like Ghoramara and Dhaspara. Interviews with ground level health workers revealed that climate impacts on physical infrastructure, access to the centres, water supply and access to medicines are the significant challenges facing by the centres. Even in Rudranagar, physical access to the centres during monsoon months is difficult, as stated by the respondents. Infrastructural damage seems greater in Ghoramara followed by Dashpara whereas centres in Rudranagar are better placed in this regard. Access to essential medicines during the emergencies is another significant concern as stated by the respondents (Figure 11).

**Figure 11: Average rating by Anganwari workers for climate impacts on the service delivery of a five point Likert scale**



Most of the Anganwadi workers stated that water logging during the monsoon or frequent inundation due to embankment breaching force the centres of the low-lying regions to stop the services. However, the respondents agreed that they always try to continue the supply of foods irrespective of water logging as people are expecting supports from them during the time of emergencies (Box: 1). The workers also unanimously agreed that storage of raw material like fuel wood, egg and vegetables is a big concern to continue services in regions like Ghoramara and Dhaspara. The respondents also stated as these regions are lagging behind in growing its own vegetables and livestock products, it became expensive to buy the food items from outside the region. Obviously, the price goes higher during monsoon, as stated by the respondents. ***“We have to cut down the egg consumption into half to save money to cover the cost of fuel wood and vegetables. These things have now become very pricy in Ghoramara due to lack of production. We have to bring everything from Kakdwip”*** –stated by one of the Anganwadi worker from Ghoramara.

***“In rainy days we have to stop giving eggs to the children. The cost of the fire wood has gone very high. We have to take a measure to balance it, and we thought of giving up for the egg”*** -stated by one of the Anganwadi worker from Ghoramara.



Similar challenges were echoed by the ASHA workers of the study regions who also have to stop their services in places due to inaccessible road conditions during emergencies. Although, being in a same village, waterlogged parts became inaccessible for them mostly during monsoon. ***“We have to stop our services when people need it most”-***

stated by one of the ASHA worker from Dhaspara. The ASHA workers stated that during the climatic emergencies like flood and inundations demand of the basic medicines, mental support, and advice for maintaining basic hygiene and child care usually get increased. The respondents agreed interrupted services often make a mental distance between them and the community as physical absence during the time of emergency affect people a lot.

***“If I won’t reach to them in their emergencies, how will they accept me well later? Trust cannot be build like this”-***stated by one of the ASHA worker from Dhaspara.

**BOX 1: Narrative of an Anganwadi Worker of one of the study village**

I am working as an Anganwadi Worker since 2002 after my marriage. Now I am in charge of three Centres. One of my colleagues is in medical leave so I am taking care of her centre too. There is no suitable candidate available in the village for taking care of the third centre. Also the girls are not willing to come from outside to provide services. So I have to take care of the centre located at southern end of the village embankment. I often send my assistant to that centre as I have to handle two other centres. During the monsoon or inundation it becomes extremely hard to reach the remote centres. Moreover, the condition of the infrastructures is not favourable to run the centre during rain or cyclone. Either the perforated roofs allows rain water to mix with the food at the time of cooking or logged water spoil the fire wood. During those times we try to cook at the centre which is centrally located and request parents and pregnant women to come and collect the foods. People usually come to collect food as they also get stuck in their houses due to adverse weather condition or flooding. As they could not go out for daily wages they also expect bit more food for the family. We try our best not to disappoint

Experiences of the ANM<sup>2</sup> and other health workers of Ghoramara and Dhaspara are quite similar with that of the Anganwadi and ASHA workers. However challenges for the ANMs are greater as they do not reside within the village. According to the respondents, they cannot reach the islands most of the days in a month during the monsoon as the only water transportation system is often suspended due to cyclonic events and flooding. The ANM respondents were also concern about availability of basic medicines during the emergencies. According to the respondents, despite of their effort to stock basic medicine prior to the monsoon months, it is difficult to predict the actual need of the people beforehand. Regions like

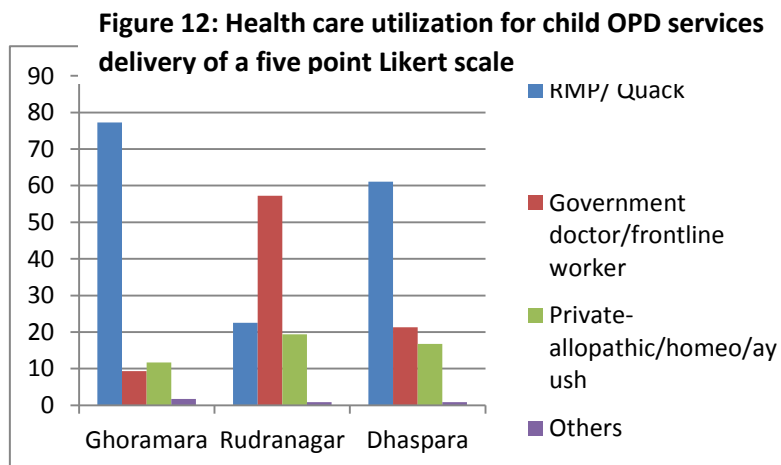
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<sup>2</sup> Auxiliary Nurse and Midwife

Ghoramara and Dhaspara suffer more by the inundation due to embankment breaching and erosion. According to the respondents, the impacts are so localized that it is hard to convince the higher ups to store unpredictable number of medicine beforehand. ***“A big event can prepare you better. But these small impacts is very unpredictable, and so as the preparation for them”***- stated by one of the ANM from one study location.

#### 4.4 Child Health care- dependence on Informal providers is high in climatically vulnerable regions like Ghoramara and Dhaspara

Access to health services is essential to ensure children get adequate care during the time of illness. Many factors determine children’s access to adequate and desirable healthcare, though we have tried to establish a link between climatic vulnerability health care accesses in the studied villages. We asked mothers with children below 6 years of age to report if their youngest child suffered from any illness in the last 30 days prior to the survey. We found that 80.59% of the children suffered from any illness in the last 30 days. Of these 90.11% of the caregivers sought care from a provider. Although, the health seeking behavior is positive, the caregivers depend on different types of providers. For example, a higher (76%) percentage of households from regions like Ghoramara and Dhaspara (61.2%) went to a rural medical practitioner (RMP) <sup>3</sup> the first time (figure 12). A similar picture is not seen in Rudranagar as that has a functional Block Primary Health Centre (BPHC) within the same locality. The BPHC turned into Rural Hospital in 2002, which have a neonatal care unit, blood bank and a pediatrician.



The number of rural medical practitioners in the three studied regions also indicates the utilization of the informal providers in the regions. Ghoramara is at the top with seven RMPs followed by Dhaspara having five and Rudranagar having two RMPs. Qualitative discussion with rural medical practitioner of the three study regions revealed accessibility and functionality of the health providers are two main reasons for seeking care from a particular provider. In case of Rudranagar where the

<sup>3</sup> Practitioners of allopathic medicine without any formal medical degree or training

Rural Hospital is functional and merged with block primary health centre, community is preferred to seek care from the public services. As the Rudranagar Block primary health centre has the facility of a pediatrician, people of the nearby villages are tending to go to the hospital as a first point of seeking care for their sick children. More so, as Rudranagar village is situated at the heart of the Sagar Island; it is quite far from the erosion prone coastal periphery. This particular village is well connected through land transportation which is playing as a catalyst to increase utilization of the public services like rural hospital and primary health centre. Informal providers and people of Rudranagar reflected that the community seeks treatment from the RMPs mainly for minor ailments. The RMPs practicing allopathic medicine stated they found it difficult to set the practice in Rudranagar as most of the people seek care from the rural hospitals. ***“If people would get a hospital nearby, why would they come to visit us”***-stated by one of the practicing RMP from Rudranagar. ***“The hospital have in-house pediatrician. This is also a big reason for the people to seek care from the hospital for their children”***-stated by another RMP from Rudranagar.

In case of Dhaspara, people showing a mixed kind of care seeking for their sick children. Dhaspara unlike Rudranagar have a higher concentration of informal providers and utilization of their services is also significant. Community stated they used to avoid going to rural hospital which is 12 km from the village and top of that road condition is not well. Though the road transportation is quite frequent in the route, people stated that during monsoon or periodic inundation it is extremely difficult to get a transport to take a sick child to the BPHC. ***“When the village gets waterlogged, how will you travel such a long distance with a sick child?”***-stated by one of the mother from Dhaspara. However, they agreed at a point that in case of emergency or if the RMPs referral, they seek care from the BPHC situated at Rudranagar. ***“We always seek the advice from the local RMP first. At the time of emergency, they are the only available option nearby. Now if we bypass them in normal time, it looks odd and embarrassing”***-stated by another mother of a 3 years old child from Dhaspara.

Ghoramara, on the other hand reflected much dependency on the RMPs as the public facilities are more inaccessible and time consuming for being a climatically vulnerable island. The only functional public facility-the sub-centre is not sufficient to fulfill the health care demand of the people. A NGO run weekly health camp through PPP model is available every Monday morning in the island. However, this facility is also sub-optimal to meet the demand especially during the climatic emergencies each year during the monsoon when both of the formal services used to close due to physical inaccessibility of such outside providers. This crucial gap is fulfilled by the RMPs who are located within the island. ***“We are always here to take care of the people. But we do not have much medical equipment and other necessary facilities***

*like blood transfusion etc. If we can somehow manage to get some facilities from somewhere, we can serve the people of Ghoramara much better*”-stated by one of the RMP from Ghoramara. Ghoramara unlike Dashpara and Rudranagar exhibits seeking care from traditional healers. Discussion with the mothers revealed they often opting the option to go to traditional healers for seeking care for their children mainly due to unavailability of any better formal or informal options. ***“We seek care from every available option we get within the island. It is very hard to get treatment outside the island as you have to incorporate transport and many other cost into it”***-stated by one of the respondents of a five years old child from Ghoramara. Findings some way indicate the flexible nature of the people of Ghoramara which they are also showing in case of livelihood. Inference can be drawn that people’s child care seeking from informal providers is part of their coping strategies while living in climatically vulnerable regions. The case of self-referral of the people of Ghoramara presented in the following box (Box 2) further strengthens this point:

#### **4.5: Preparedness of the existing health care system to deal climatic vulnerability**

##### **BOX 2: Skipping the distance-the self-referral of the people of Ghoramara**

The island of Ghoramara is administratively under the Sagar Block. The people of Ghoramara should be catered under the Block Primary Health Centre located at Sagar. However, people preferred to go to the Kakdwip sub-divisional hospital to seek care even for minor ailments. However, all the Government health schemes and facilities for the people of Ghoramara are affiliated to the Sagar BPHC. Kakdwip, the sub-divisional town, is a 45 minute boat ride from the island Ghoramara. On the other hand, if one have to go from Ghoramara to Sagar, he/she have to come first to Kakdwip and then change the ferry service and catch the boat for Sagar which is again an hour’s affair. Total travel time from Ghoramara to Sagar is 1.45 hours by boat despite the time taken due to low tide and availability of the boat. The direct transportation link between Ghoramara and Sagar has broken around 15 years back due to repeated erosion in Ghoramara and neighbouring islands and related siltation in the river. Due to the present condition of Ghoramara, Kakdwip became a point of referral for the people of Ghoramara not only for the care seeking, but also for the market and livelihood linkages. So it is easier for the people of Ghoramara to seek care from the Kakdwip hospital other than going to Sagar which usually take a whole day including the waiting time in the hospital. To handle the patient load from Ghoramara, Kakdwip sub-divisional hospitals have made some special arrangements like giving preferences in the queue or providing the beneficial schemes to them. However, no formal arrangement has been made yet.

Additionally, Kakdwip being a sub-divisional town, the private formal and informal health care options are plenty. For example, there are good numbers of private nursing homes in Kakdwip. If required, people can directly take the patient to Kolkata- the mega city located 120 km from Kakdwip for state level health facilities. Hence, availability and accessibility of quality health care options indulges self-referral of the people of Ghoramara by skipping the actual point of care seeking.

To understand the preparedness of the existing health care system towards climatic vulnerabilities, we explored the responses in terms of knowledge, skill (training) and motivation and readiness in terms of condition of the infrastructures to withstand climatic shocks.

## **Knowledge**

Though climate change impacts became more visible since last two decades, frontline health care providers lack the required knowledge to link the climatic changes and variability with the health of the children. This is somehow expected as climate change and health is still an emerging area. However, during the interviews most of the providers-be it formal or informal frequently mentioned significance of climatic events while describing child health conditions. Instead of understanding the link to bigger manifestation of the climatic changes like sea level rise or changes in livelihood due to salinity intrusion, the understanding is limited to seasonal variability and climatic emergencies like flood or cyclone. Providers from Rudranagar provided more stress on the lack of general awareness of the parents as a reason for child health condition than any climate related outcomes. ***“All they need is an immediate impact. What would be good for the children in future do not bother them much”***-stated by one of the nutrition care provider of the study region. Although, they mentioned that parents', specially the mother's livelihood changes due to increasing climatic events has significant affect on child's health and nutritional status. ***“Now in most of the households mothers are also working to restore flood related livelihood damages. They hardly have any time or awareness to take care of the baby. How would their child be healthy?”***-stated by one of the ASHA worker from Rudranagar. The frontline workers of Dhaspara, nevertheless agreed that recurrent water logging has an impact on the health of the children. ***“The children of low lying areas are suffering more from water borne diseases as the households often get waterlogged due to flooding and inundations. Each time they recover to fall again in another spell of illness. This is making them malnourished too”***-stated by a frontline health worker from Dashpara. On the other hand, providers form Ghoramara especially the informal providers who themselves belongs to the community are better able to link the child health and nutritional condition with the climate change manifestations of the island than others.

***“The island is shrinking. People are losing their food due to lack of land and fresh water due to salinity intrusion. Expenses are much higher now than the income. People do not have much livelihood options. They are maintaining the households with outmost stress. How can the child get proper nutrition and care?”***-stated by one of the Informal provider from Ghoramara.

The block level medical authorities admit that the climatic shocks have a direct impact on livelihood uncertainties and related complexities which may have an impact on the health and nutritional status of the children. Big events like flood or cyclone have more influence on their perception regarding the linkage between climate change and health than the slow and gradual shocks like erosion or periodic inundation. The big events imposed emergency situation like rise in water borne diseases or drinking water crisis. These public health emergencies usually create awareness amongst the block level health functionaries concerning climate impacts on health. ***“It is a flood prone area like many other parts in Bengal. Every year we have to prepare ourselves for the emergency situations like flood so that we can response as early as possible”***-stated by one of the block level health functionary. However, perception limiting to emergency response is missing out the constant gradual changes in the external environment of child health and its determinants.

A probable reason for this knowledge gap may be due to differential vulnerability towards climate change impacts across the region. The differential impacts are making the different level of providers confused regarding the pathways and extent of real impacts of climatic changes on child health in the Sundarbans.

### **Skill and motivation**

In terms of technical training the providers of three regions have formal medical training to handle preventive and curative challenges of mother and child health. However there is no such specific training to handle public health emergencies arise after disaster. Health functionaries at different level unanimously agreed that training on disaster management limited to giving first aid and evacuating people. There is no such element of handling diseases outbreak or contingency planning in the training. ***“One of our blocks level health staff got the training on disaster related evacuation on our behalf. There is no such training for the frontline health providers who actually work on the ground”***-stated by one of the health functionaries at BPHC. Providers stated that they store some emergency medicines and other materials as a part of contingency planning. They also agreed that information about stored medicine or food have to be sent to the headquarters especially before the monsoon. According to a senior block level health professional at every Primary Health Centre, the medical team comprising of a doctor, senior nursing staffs and ANM usually handle the emergency situation at Gram Panchayet level. Though, he agreed to the point that there is no specific training on disaster management for the health professionals to handle climatic emergencies other than how to provide first aid.

Motivation-one of the most significant component of any health workforce seems falling in the lower side as transportation of the island areas are not favorable. Situations aggravate during the monsoon and

climatic emergencies which scared the providers residing outside the island who have to travel daily for providing services. Higher level medical authorities admitted that sometimes the ground level staffs lack the motivation due to the hazardous and fearful travel in the islands. They sometimes arrange motivational trainings for the workers; however, the effect is not long lasting. ***“We arrange motivational camps for our staffs. After those 2-3 months all go well. But after that the same thing started happening”***-stated by one of the health supervisor of the study block. Some of the block level health functionaries pointed out that lack of community participations in the health programs also de-motivate the front line health functionaries. ***“There is a motivational and communication gap between the community and the health staff. Both are responsible for that. If our staffs are not motivated, community also on the other hand is not very much interested in the ongoing health programs. They are just busy with earning their livelihood”***-stated by one of the block level health functionaries. The block health authorities also express their concern that new programs like 12 hours services at the Anganwadi Centers to serve the working mother better need more dedicated and motivated ground level health staff. The program needs more incentive and better communication between community and health workers to promote these special kinds of services. ***“A new scheme on Early Childhood Development would be introduced shortly. Then we can provide better services to the children. However, as the environment is not child friendly we need motivated workers and assistants to run the programme”***. –One of the health functionaries of studied block.

### **Infrastructure**

Findings from facility survey revealed some critical gaps in-terms of their preparedness with the climatic adversities. Only 3 out of 10 studied Anganwadi Centers had access to electricity and toilet facility. Although basic equipment like weighing scale and growth monitoring chart were available for all centres. Discussions with Anganwari Centers revealed that out of 10 only 4 of the AWW were trained in growth monitoring of children. Most of the Anganwadi centres of the Sagar Block do not have building of their own. Of total 371 centres, only 70 centres of the block own a building, which is a typical character of a disadvantageous region. Although the sub-centre building of Ghoramara built of concrete, it is situated in a low lying area; hence gets waterlogged almost in every monsoon. ***“Though we have concrete centre but it is situated in the low lying areas. We have to face the challenges of water logging each year. But those who have temporary structures had to face severe problems while delivering services during embankment breaching or flooding. They have to have a make shift arrangement in people’s courtyard”***-stated by one of the front line health worker from Ghoramara. The building has toilet facilities but lacks electricity. Dashpara, at the time of the study, lack any permanent infrastructure for sub-centre.

The centre is running its functions from different Anganwadi centres of the village. ***“The local club first approached the house owner to build the centre here. The house owner just put four bamboo poles and thatched them with straw as a cooking point. One point in time some NGO also promised to replace the structure into a concrete one. But nothing happened. We have informed the Panchayet. May be they will help. The structures are breaking down and surely cannot withstand next monsoon. We cannot store extra fire wood for monsoon as we don’t have a proper building”***-stated by one of the health worker from Dhaspara. Needless to say during the emergencies the services got hampered greatly due to lack of infrastructural facilities. Rudranagar sub-centre on the other hand scored much better position with all the required facilities like toilet, concrete building and electricity. The situation is well reflected in the following statement of one of the health functionary working in Rudranagar- ***“We do not have issues with flooding or cyclones other than usual thunderstorms. But as we have concrete structures we don’t have to face many problems. We can store fire woods and other resources safely in the centre”***.

#### **4.6 Conclusion:**

The existing health care delivery system is implementing various plans and programs related to child health and nutrition for the Sundarbans’ children. Health and nutritional care services across the three tier –Primary, Secondary and Tertiary are well established and in most of the cases are functional in nature. However, the facilities are less prepared to handle the climatic vulnerabilities that the people of Sundarbans are facing at present. The main gaps seem to be present at their knowledge to link child health situation with climatic vulnerabilities; skill and training of the human resources to handle climatic emergencies; and resilient health care infrastructures. Nevertheless, the grass root human resources for health and nutritional care are motivated enough as they are the sole witness of the suffering of the children belongs to climatically vulnerable regions. But they do not have requisite infrastructure or training to link the emerging vulnerabilities due to climate change manifestations. Motivation, somehow lose its foothold in the upper layers of the care delivery system, however, the gap in knowledge and skill are persisting well. Finally, climate and its consequences are limited only in disaster preparedness planning and are not at all reflected in long term adaptation planning process.

An inference can be drawn that differential vulnerabilities is not only impacting the households but also the health care delivery system. Rapid changes in Sundarbans’ land mass due to erosion and destruction by climatic shocks make the existing map of service points revolving towards greater inaccessibility. More so, poor condition of existing health and nutritional infrastructures often force the services to be shut down especially during the climatic emergencies. It also creates confusions amongst the state health



policy makers about the extent of impacts across the Sundarbans. In some places it is the erosion whereas in some places it is the periodic inundation which is impacting the health of the children. This is creating a fragmented knowledge in terms of health policy planning and implementation leading mainly towards emergency response.

Exposure, sensitivity and adaptive capacity of healthcare delivery system are similarly needed to be understood in the light of the present climatic condition of the Sundarbans. To what extent the health care facilities are equitably distributed according to regions' geographical sensitivity to cater the vulnerable communities are a need to be understood, re-visit and modify.

## **Section 5: Conclusion**

### **5.1 Introduction**

Climate change is a physical phenomenon; however, it is mediated through socio-cultural and economic system of a given context. Within the contextual vulnerabilities, there are layers of differential vulnerabilities which may change the experience of climatic adversities and consequences it has created on the health of the population. Even though extreme exposure to climatic adversities and high sensitivity can destroy physical and social determinants of health, it is the ability of the households, community and system to cope from the loss that determines the extent of climatic impact within a given context. This adaptation process is not at all linear and requires top-down as well as bottom-up approaches. In most of the cases policies and programs fail to understand these factors and process a more generalized implementation plan. Though climatic changes became more visible since last two decades in the Sundarbans, the health care delivery system lacks the required knowledge and skill to link the changes with the sufferings of the people. The policy actors are uncertain both of the local affect of the global climate change in coastal Sundarbans and nuanced understanding of dynamic coping strategies of the islanders. The lack of convergence between the grass root health workers and their higher authorities prevented a re-evaluation of the threat and risk of the child health in the region.

### **5.2: Summarizing key challenges and plausible recommendations**

Geographical inaccessibility, socio-political marginality and poverty were the characteristics of Indian Sundarbans since its inception of human habitation during the colonial rule. Climatic changes and related adversities since last two-three decades have increases the manifold challenges of the islanders to a great extent. The key challenges include:

#### **1) The complex pathway of climate impacts on children's health in the Sundarbans**

Climate is impacting the child health in both direct and in-direct ways. Directly it is impacting through increasing number of water borne diseases, injuries, and food shortage during disasters like flood and cyclone. Indirectly, it is impacting the food production system of the region through salinity ingress and land erosion, eventually leads certain socio-economic changes which intern impact child health indicators like under-nutrition and morbidity. Overall, climate is impacting child health by damaging physical as well as social determinants of child health in Sundarbans.

#### **Recommendations:**

1. Recognize climate change as a crucial determinant for the health of the Sundarbans' children. Existing and future plans for and implementations in the Sundarbans need to incorporate measures to combat climate change impacts to become climate sensitive and resilient.
2. Equitable distribution of resources to address social determinants of health may be a significant alternative. For example, training on alternative livelihood generation should be a priority in the vulnerable pockets where traditional agro-fishing livelihood is heavily affected.

## **2) Differential vulnerabilities across Sundarbans region**

The Sundarbans is no homogeneous entity. There are many Sundarbans within the Sundarbans. Region-specific vulnerabilities are hindering the wholesome understanding of the Sundarbans' vulnerabilities towards climatic changes. Vulnerability of the community largely depends upon their sensitive geographic position and differential socio-economic ability to cope with the climatic challenges. Hence, a 'fit to all' policy stand point is not recommended for Sundarbans..Ground level administrators need clearer understanding of how climatic threats are impacting the life of the people of Sundarbans in order to understand their challenges.

### **Recommendations:**

1. Redefine the map of Sundarbans in terms of livelihood depletion-household food security and children's vulnerability pathway.
2. Map the specific vulnerabilities of different geographies across Sundarbans (Islands, coastal belt, mainland); vulnerable groups (migrant households, crab catchers etc.) and existing assets, available resources and social capital of those groups and locations respectively.
3. Training of the ground level administrative staffs regarding the differential vulnerabilities in order to understand geographically specific impacts of climate change and challenges of the people. Incorporate scientific evidence in tangible manner in the training procedures.
4. Revisit every existing plan and program for Sundarbans under the changing climatic conditions.

## **3) Climate as a crucial factor for catalyzing food insecurity and hunger risk**

Climate is posing a serious threat to the food system of the Sundarbans by impacting its major components like food productivity, food availability, food affordability and food choices. Together these factors serve to increase the burden of under-nutrition and recurrent morbidity among children as well as adults and push them towards hunger. At the same time, as the impacts are different and depend also upon people's adaptive capacities, policy vibrancy is highly recommended.

**Recommendations:**

1. Strong surveillance mechanism needed for the children to monitor the under-nutrition status
2. State-led innovative measures like supplying vegetables and fruits through the public distribution system may help to reduce the food availability of the region
3. Specific programs on child care support are necessary for women with seasonally migrant husbands. Alternate livelihood generation schemes, increase in number and in hours of Anganwadi centers; and hands-on training on nutritious food preparation with available local resources can be arranged for them.

**4) Lack of preparedness of existing health care system to deal with climatic adversities**

The existing health care delivery system lacks the understanding, planning and preparedness to address climatic vulnerabilities of the health of the Sundarbans children. Its governance, finance, human resource and infrastructure are not adequate to deal with the climatic adversities that Sundarbans is presently facing. Lack of bottom-up voices of the grass root health functionaries make the policy implementation highly top-down which make it difficult for ground level challenges to reach the ultimate layer of policy making.

**Recommendations:**

1. Health policy making for Sundarbans urgently requires recognition of climate change as a crucial determinant of child health. The newly formed Cell on climate and health under the State Department of Health and Family Welfare requires evidence-based strengthening of plans and programs.

2. Every component of the health care delivery system needs re-modeling in the light of WHO's Climate Resilient Health System Framework to deal with short and long term impact of climatic changes.
  - a. Separate training in climate-health linkage is essential for the health human resources serving in the Sundarbans.
  - b. Health infrastructures across the Sundarbans require to be made climate sensitive irrespective of their geographic positions (low-lying or mainland).
  - c. Increasing the number of facilities and resources in climatically vulnerable pockets would help to tackle the changes better.