

Living on the Edge: Climate Change and Uncertainty in the Indian Sundarbans

Upasona Ghosh, Shibaji Bose, Rittika Bramhachari

Sundarbans

A large abstract graphic consisting of several overlapping, curved, brush-stroke-like lines in various shades of green and grey, filling the lower half of the cover.

Living on the Edge: Climate Change and Uncertainty in the Indian Sundarbans

The Sundarbans is a coastal delta and major climate hotspot located at the southern end of Bangladesh and in the state of West Bengal in India. The delta faces significant climatic and other ecological challenges (e.g. disappearing mangrove forest, islands affected by rising sea levels, erratic rainfall and cyclones). There has been a lot of documentation on climate change impacts and their uncertainties in the Sundarbans. However, this theorization has largely been from 'above' by experts, natural scientists, and modellers who have documented and debated the various manifestations of climate change in this dynamic delta where several Himalayan Rivers drain their basins. What's missing is how the local islanders view and live with these uncertainties and manifestations of climate change, and what these mean for their daily lives and livelihoods. This working paper seeks to examine climate change and uncertainty in the context of how diverse actors, especially, everyday men and women in the Sundarbans, live with, understand and cope with climate change and uncertainty. We demonstrate that even though uncertainties related to climate change are increasing, local people are attuned to living and coping with them. Still, climate change uncertainties and other drivers of change are now increasing their vulnerability and ability to cope. Largely, the 'above' has tended to ignore local realities and close down pathways for more inclusive adaptation. Thus, a multiplicity of knowledge and approaches need to be deployed to promote adaptation in the Sundarbans that respond to the socio-ecological diversity of contexts and is socially just.

About the authors

Upasona Ghosh is a Senior Research Officer at the Indian Institute of Health Management Research. A Social Anthropologist by training, she gained six years of experience carrying out ethnographical work in the disadvantaged Sundarbans region of India. She worked on the social determinants of health with a particular emphasis on the linkage between climate, society and health. Her areas of work include: climate change in relation to gender and mental health; societal transformation; and responsive health systems.

Shibaji Bose, a former journalist, has worked in the sphere of advocacy and research uptake with various government agencies and media outlets for over a decade. He has led and supported communication campaigns on health systems and climate change for various national and international consortia. In addition, Shibaji has worked with innovative research methodologies such as photovoice in different parts of India that seek to 'translate' the voices of ordinary people to governments and civil society actors.

Rittika Brahmachari is currently MEL (Monitoring, Evaluation and Learning) Coordinator at Children International (CI) - Sahay. Prior to joining CI she was a Research Officer at the Indian Institute of Health Management Research (IIHMR), working in particular for the Johns Hopkins-led research consortium Future Health Systems. She has gained expertise in monitoring and evaluation and participatory methods in research and evaluation.

About the STEPS Centre

Today's world is experiencing rapid social, technological and environmental change, yet poverty and inequality are growing. Linking environmental sustainability with poverty reduction and social justice, and making science and technology work for the poor, have become central challenges of our times. The STEPS Centre (Social, Technological and Environmental Pathways to Sustainability) is an interdisciplinary global research and policy engagement hub that unites development studies with science and technology studies. We are developing a new approach to understanding and action on sustainability and development in an era of unprecedented dynamic change. Our pathways approach aims to link new theory with practical solutions that create better livelihoods, health and social justice for poor and marginalised people. The STEPS Centre is based at the Institute of Development Studies and SPRU (Science Policy Research Unit) at the University of Sussex, with partners in Africa, Asia and Latin America. We are funded by the ESRC, the UK's largest funding agency for research and training relating to social and economic issues.

www.steps-centre.org.

Follow us on Twitter [@stepscentre](https://twitter.com/stepscentre)

Other titles in this series include:

- | | |
|-----------------------|--|
| Approach | Pathways to sustainability: an overview of the STEPS Centre approach |
| 1. Dynamics | Dynamic Systems and the Challenge of Sustainability |
| 2. Governance | Understanding Governance: pathways to sustainability |
| 3. Designs | Empowering Designs: towards more progressive appraisal of sustainability |
| 4. Agriculture | Agri-Food System Dynamics: pathways to sustainability in an era of uncertainty |
| 5. Health | Health in a Dynamic World |
| 6. Water | Liquid Dynamics: challenges for sustainability in water and sanitation |

For more STEPS Centre publications visit:

www.steps-centre.org/publications



Living on the Edge: Climate Change and Uncertainty in the Indian Sundarbans

Upasona Ghosh, Shibaji Bose, Rittika Bramhachari

STEPS Working Paper 101

Correct Citation: Ghosh, U., Bose, S. and Bramhachari, R. (2018) *Living on the Edge: Climate Change and Uncertainty in the Indian Sundarbans*, STEPS Working Paper 101, Brighton: STEPS Centre

© STEPS 2018

Some rights reserved – see copyright license for details

ISBN: 978-1-78118-411-0

Acknowledgements

The authors, part of the IIHMR University research team 'Uncertainty from Below', would like to thank the ESRC STEPS Centre for funding this research. Especially we wish to thank Lyla Mehta for her inspiration and support, as well as Ian Scoones and Harriet Dudley for their support. We also thank the Norwegian Research Council and Norwegian University of Life Sciences (NMBU) for their additional funding. We acknowledge the support and suggestions from Dr Alankar (CSDS, Delhi) and Dr. V. Vijaykumar (GUIDE, Kutch, Gujrat) and thank Lars Otto Naess (IDS, Sussex) and Darley Jose Kjosavik (NMBU, Norway) for their suggestions when reviewing the paper. We thank Professor Barun Kanjilal for this support and inspiration, as well as Dr Manasee Mishra for her administrative support and Sujan Sakar for his work on data collection and analysis. Our thanks also to Jan Boyes for her excellent copy editing skills.

We thank the Government officials, Scientists, Journalists and Development professionals for their support and interest, not only taking part as respondents but also providing insightful suggestions for the research and we look forward to future collaboration. Finally we must thank everyone in study blocks and villages of the Sundarbans, local CBOs, NGOs and other associations for their constant support without which we could not have pursued this study.

For further information please contact: STEPS Centre, University of Sussex, Brighton BN1 9RE

Tel: +44 (0) 1273915673; Email: steps-centre@ids.ac.uk; web: www.steps-centre.org

STEPS Centre publications are published under a Creative Commons Attribution – Non-Commercial – No Derivative Works 3.0 UK: England & Wales Licence (<http://creativecommons.org/licenses/by-nc-nd/3.0/legalcode>)

Attribution: You must attribute the work in the manner specified by the author or licensor.

Non-commercial: You may not use this work for commercial purposes.

No Derivative Works: You may not alter, transfer, or build on this work.

Users are welcome to copy, distribute, display, translate or perform this work without written permission subject to the conditions set out in the Creative Commons licence. For any reuse or distribution, you must make clear to others the licence terms of this work. If you use the work, we ask that you reference the STEPS Centre website (www.steps-centre.org) and send a copy of the work or a link to its use online to the following address for our archive: STEPS Centre, University of Sussex, Brighton BN1 9RE, UK (steps-centre@ids.ac.uk).



Contents

List of Tables, Figures and Boxes	iii
Acronyms	iv
Abstract.....	vi
1. Introduction	1
2. Methodology.....	3
2.1. Settings and Data	3
2.1.1. Study Village One	3
2.1.2. Study Village Two.....	3
2.2. Methods and Approach	4
2.2.1. Ethnography, Semi-structured Interviews and Participatory Rural Appraisal with the 'below' ...	4
2.2.3. Key Informant Interviews with the 'Middle'	5
2.2.4. Key Informant Interviews with the 'Above'	6
2.3. Data Analysis.....	6
3. The Sundarbans.....	7
3.1. Sundarbans: the 'Beautiful Forest'.....	7
3.2. People of Sundarbans: Demography	8
3.3. People of Sundarbans: History	9
3.4. Bonbibi: the Goddess of Syncretism	10
4. Climate Change in Sundarbans: Glimpses from the Literature.....	11
4.1. Climate Change Trends	11
4.2. Cyclone Aila as a Key Event.....	12
5. Sustaining Livelihoods Amidst Climate Change Related Uncertainties and their Interactions with Other Drivers of Change	14
5.1. Agriculture and Food Security	14
5.2 .Fishing	18
5.3. Alternative Livelihoods	20
5.4. Coping Strategies	21
5.5. Perceptions of the 'Middle' on Livelihood Uncertainty	21
5.6. Perceptions of the 'Above' on Livelihood Uncertainty	23
6. Climate Change and Health Systems	26
6.1. Introduction	26
6.2. Perception from the 'Below' on Uncertainty of Health	27
6.3 Coping strategies	29
6. 4. Perception of the 'Middle' on Health Uncertainty	29
6.5 Views from the 'Above' on Health Uncertainty.....	31

7. The Controversies Around Embankments	33
7.1 Introduction	33
7.2 Perception of the 'Below' on the Embankments	33
7.3 Coping Strategies	35
7.4 Perception of the 'Middle' on Shelter Uncertainty.....	36
7.5 Perception of the 'Above' on the Embankments.....	37
8. Institutional Arrangements and the Lack of Coordination	39
8.1 The Project-Policy Dissonance	39
9 Discussion and Conclusion	43
9.1 Discussion	43
9.2. Conclusions	44
References	46
Annex: Lists of Stakeholders	50

List of Tables, Figures and Boxes

<i>Figure 3.1: Position of Sundarbans India</i>	7
<i>Figure 5.1: Waterlogged Agricultural Lands after Cyclone Aila due to Saline Water Intrusion From the Sea</i>	16
<i>Figure 5.2: Meendhara - the Traditional Way of Catching Small Fish</i>	19
<i>Figure 5.3: Jari Work as a Means of Alternative Employment</i>	20
<i>Figure 5.4: Migration of Male Islanders for Alternative Livelihood Options</i>	21
<i>Figure 6.1: Daily Number of Diarrhea Cases Attending Gosaba BPHC and Rangabelia TSRD Clinics after Cyclone Aila (May 31 - June 30, 2009)</i>	26
<i>Figure 7.1: Land Erosion Over the Past Forty Five Years</i>	34
<i>Figure 7.2: Temporary Embankments</i>	36
<i>Figure 7.3: Temporary Tents on the Embankments (for families who lost their houses after Cyclone Aila)</i>	36
<i>Table 5.1: Seasonal Calendar: a participatory rural appraisal tool</i>	15
<i>Box 5.1: Hazard-Vulnerability and Capacity Assessment</i>	17
<i>Box 8.1: Structure of Sundarbans Development Board (SDB) and Sundarbans Affair Department (SAD) (from the website of the SAD)</i>	39

Acronyms

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 Organisations
CDC	Community Delivery Centre
CSE	Centre for Science and Environment
DoHFW	Department of Health and Family Welfare
FGD	Focused Group Discussions
FHS	Future Health Systems
GP	Gram Panchayat
GIT	Gastro Intestinal Tract
ICDS	Integrated Child Development Schemes
IHMHR	Institute of Health Management Research
IMD	Indian Meteorological Department
IPCC	Intergovernmental Panel on Climate Change
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Schemes
MLA	Member of the Legislative Assembly
NGO	Non-Governmental Organisation
NHM	National Health Mission
OBC	Other Backward Class
PHC	Primary Health Centre
PIPA	Participatory Impact Pathway Assessment
RGSRY	Rajiv Gandhi Swavlamban RozgarYojna
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 Project
TSRD	Tagore Society for Rural Development
UNESCO	United Nations Educational, Scientific and Cultural Organization

Abstract

The Sundarbans is a coastal delta and major climate hotspot located at the southern end of Bangladesh and in the state of West Bengal in India. The delta faces significant climatic and other ecological challenges (e.g. disappearing mangrove forest, islands affected by rising sea levels, erratic rainfall and cyclones). While there has been a lot of documentation on climate change impacts and their uncertainties in the Sundarbans, this has largely been from 'above' by experts, natural scientists and modellers. What is missing is how the local islanders view, and live with, these uncertainties and manifestations of climate change and what these mean for their daily lives and livelihoods. This working paper seeks to examine climate change and uncertainty in the context of how diverse actors, especially men and women in the Sundarbans, live with, understand and cope with climate change and uncertainty. The paper demonstrates that even though uncertainties related to climate change are increasing, local people are attuned to living and coping with them. However, climate change uncertainties and other drivers of change are now increasing which is affecting the local people's vulnerability and ability to cope. Largely, the 'above' has tended to ignore local realities and as well as closing down pathways for more inclusive adaptation. Thus, a multiplicity of knowledge and approaches need to be deployed to promote adaptation in the Sundarbans that respond to the socio-ecological diversity of contexts and is socially just.

1. Introduction

The Sundarbans is a coastal delta and major climate hotspot located at the southern end of Bangladesh and in the state of West Bengal in India. The Indian Sundarbans comprises of 54 islands and is home to about 5 million people (Government of India 2011). The delta faces significant climatic and other ecological challenges (e.g. disappearing mangrove forest, islands affected by rising sea levels, erratic rainfall and cyclones). The residents are largely landless subsisting on agriculture and fishing. Poverty and deprivation are both high, with migration emerging as a major development issue in recent years. In the past decades, climate change stressors such as a rising sea level, land erosion, erratic patterns of rainfall and temperature have been profoundly changing the ecology, lives and livelihoods in the Sundarbans. There has been a lot of documentation on the impacts of climate change and their uncertainties in the Sundarbans (see Section 3). However, this theorisation has largely been from 'above' by experts, natural scientists, and modellers who have documented and debated the various manifestations of climate change in this dynamic delta where several Himalayan Rivers drain their basins. What is missing is how the local islanders view and live with these uncertainties and manifestations of climate change.

This working paper seeks to examine climate change and uncertainty in the context of how diverse actors especially, everyday men and women in the Sundarbans live with, understand and cope with climate change and uncertainty. By building on social science and qualitative approaches that seek to understand the nature, discourses, impacts and responses to climate change (e.g. Wynne 2010; Crate and Nuttall 2009), we respond to Jasanoff's call to synchronise scientific framings of climate change with 'the mundane rhythms of lived lives and specificities of human experience' (Jasanoff 2010: 238). We use the heuristic of 'above', 'middle' and 'below' (see Mehta *et al.* forthcoming) to analyse diverse discourses and practices around uncertainty and climate change in the Sundarbans.

We demonstrate that even though uncertainties related to climate change are increasing, local people are attuned to living and coping with them. However, climate change uncertainties and other drivers of change are now increasing their vulnerability and ability to cope. In general, the 'above' has tended to ignore local realities and as well as closing down pathways for more inclusive adaptation. Thus a multiplicity of knowledge and approaches that respond to the socio-ecological diversity of contexts and is socially just need to be deployed in order to promote adaptation in the Sundarbans.

We draw on Walker *et al.* (2003: 5) who define uncertainty as 'any deviation from the unachievable ideal of completely deterministic knowledge of the relevant system'. They distinguish between *epistemic uncertainty* (arising due to the imperfection of our knowledge) and *ontological or variability uncertainty* (due to inherent variability in human and natural systems concerning social, economic and technological developments). Both will be framed and interpreted differently by different actors and these framings will be linked to relations of power that justify different institutional practices and responses (cf. Rein and Schön 1993). We take an *interpretative* approach (Jasanoff and Wynne 1998) to look at climate change as a social phenomenon, where the perceptions of different actors are guided by their frame of knowledge and its rootedness in particular social, cultural and political contexts (Goffman, 1974)

The research was conducted by a team of researchers from the Indian Institute of Health Management Research¹ as part of a STEPS Centre funded project on 'Uncertainty from Below' by building on the heuristic of Mehta *et al.* (Forthcoming), the paper focuses on different layers of actors to include:

¹ Established in 1984 in Jaipur, the Institute of Health Management Research (IHMR) is a specialised Research University, postgraduate education and training exclusively in the health sector.

'above', scientists, modellers and policy makers; 'below' the islanders who are differentiated by caste, wealth, gender and religion; and 'middle', non-governmental organisations (NGOs), community based organisations (CBOs), media, and activists acting as facilitators and advocators in between the 'above' and 'below'. The study takes an ethnographic approach, along with participatory rural appraisal techniques and semi-structured interviews, to explore climate change related uncertainties in the Southern part of the India Sundarbans, the area most affected by climate change.

By analysing the perceptions of the 'above', 'middle' and 'below' regarding climate related uncertainties in the Indian Sundarbans, we show diverse framings of climate change related impacts and their uncertainties. We demonstrate that while uncertainty is not a new phenomenon for local people, climate change and the impacts of other anthropogenic interventions (e.g. port development, commercial fishing and top down government policies) are increasing the vulnerabilities of local people. Furthermore, local people have to grapple with issues arising from forced displacement, difficulties in sustaining livelihoods, and systematic government neglect. While it is widely acknowledged that climate change is profoundly affecting the Sundarbans, there are differences of opinion regarding attribution, that is, whether some of the changes are due to climate change *per se* or whether there are other anthropogenic causes of the changes.

In the Sundarbans, dominant pathways to deal with uncertainty and climate change range between top-down infrastructure-led development, to apathy and neglect of the vulnerabilities of poor people. Official knowledge from 'above' has tended to ignore the day-to-day experiences and practices of local people around uncertainty, thus missing out on local-level detail. These 'decontextualised' top-down policies have tended to hamper efforts to support locally appropriate and socially just adaptation of the local people to the changes.

The paper is structured as follows: the next Section describes the methodology of the paper showing the core approach-ethnography, its application in the field and details of other applied tools. It also provides details of the respondents from different layers. Section 3 examines the different aspects of Sundarbans starting from describing the 'beautiful forest', its people, and historiography and climate change manifestations. Section 4 focuses on climate change impacts on local livelihoods and how local people are responding to these. It also looks at the perception of the 'middle' and 'above' concerning livelihood uncertainties in the Sundarbans. Sections 5 and 6 examine health and shelter related issues concerning climate change, the coping strategies of local people and views of the 'middle' and 'above' on these issues. The paper then examines the complexities around institutional arrangements dealing with climate change and uncertainties before turning to the final conclusions.

2. Methodology

2.1. Settings and Data

The study was conducted in two villages of the Indian Sundarbans which are administratively under Patharpratima and Namkhana Block of South 24 Paraganas District. We divided the study regions into two geographic locations – deltaic (completely river locked) and non-deltaic (connected with the mainland at least on one part) – to ensure a comparative understanding of geo-climatic vulnerability and multi-ethnicity. Geographical hurdles, proximity to reserve forest and frequency of climatic shocks were used as measures to understand the critical issues of uncertainties experienced by the 'below', the primary layer of actors experiencing climate change in their daily lives.

2.1.1. Study Village One

The first village chosen was Dakshinkashinagar in Herambogopalpur Gram Panchayat (GP), PatharPratima block, 24 Parganas (S) with a total population of 6045. The village has four hamlets and is surrounded by the Thakuran River and Sibua River. Two hamlets are more vulnerable to climatic shocks because of their proximity to the Bay of Bengal. The houses are mainly *kaccha* with straw roofs but after cyclone Aila in 2009 some houses are now being built out of concrete. Ponds are the main source of drinking water though they are becoming saline.²

The village has electricity on one side but households living near the embankment are without electricity. The village has a flood centre constructed by the government but it is situated quite far from the hamlets that are affected most. The population is mainly composed of Scheduled caste (SC) and other so-called backward caste (OBC) population.³ Health facilities are poor and the villagers are totally dependent upon the Rural Medical Practitioner (RMP) or informal health providers. There is a community delivery center in the nearby village in which two other visiting doctors are available twice a week. The village is connected with the nearby town only by boat. Within the village dust roads exist which are used by cycle rickshaws. The majority of young males, approximately aged between 18–45 years, have migrated to Indian cities such as Kolkata, Kerala, and Delhi. The population that is left is composed of males aged 60 and above and females of all ages. This left behind population is now subsisting on residual fishing, wage laboring both in agricultural and non-agricultural field. Drinking water facilities and electricity are available in the village.

2.1.2. Study Village Two

The second village is situated along the confluence of two rivers, HataniaDoaniya and Muriganga and is adjacent to Nakkhana. A total of 70 metres of temporary embankments have been constructed to protect the village from the coastal erosion. The population of the village is approximately 575 in 150 multiethnic households. Since July 201 about 35 households have been forced to move to the interior of the islands due to the changes in the river movements and the resultant erosion of the embankments. By contrast, towards the east of the village accretion activities are taking place.

Agriculture and fishing are the two major livelihood options for the villagers. However, both of these are facing stress due to growing salinity of agricultural fields and river water, which is leading to the majority of males migrating away from the village. Even school age boys join their elders in this

² Aila was a moderate cyclone that had devastated impacts on many parts of Sundarbans. Aila struck Sundarbans in May 2009 causing significant casualties and damages.

³ Caste is an ascriptive and hierarchical social grouping in India. Societal privileges and discrimination are institutionalised for different caste groups.

migration to boost family incomes. Young females (daughters and newly-wed daughters in law) are also joining the work force for the same reason.

Health facilities are situated in more or less accessible distance from the village. The sub-centre is located one kilometre from the village, whereas the Block Primary Health Centre (BPHC) and the sub-divisional hospital are three and 14 kilometres from the village respectively. There are a reasonable number of RMPs locally.

The village has an almost complete lack of any proper hygienic sanitation. Villagers are unable to build permanent toilets due to the need they have to rebuild their homes frequently because of the breaching of embankments leading inundation. The main source of water (for drinking and for other purposes) is from one tap. When the tap dries up or gets contaminated during the high tides, villagers have to travel a distance of 1.5 kms to use water from the tap located at a nearby primary school. However, the village has well connected electric supply. There is only one community based organisation, whose main role is to provide microfinance to the women villagers.

2.2. Methods and Approach

2.2.1. Ethnography, Semi-structured Interviews and Participatory Rural Appraisal with the 'below'

This study draws on an ethnographic approach – namely the detailing of social interactions of people from their own point of view, through immersion of investigators into the everyday social worlds they are studying (Reeves *et al.* 2008). Ethnographic observation and engagement with Sundarbans communities regarding their perception on climate change, and its impacts on the main drivers of life like health, livelihood and embankments started in March 2013 and ended in April 2014. Over this time, one trained ethnographer along with two research assistants visited the study villages 50 times, seven days at a time, maintaining an observation checklist and a field diary. The research assistants were trained on the objectives, methodologies (ethnographic observation and participatory rural appraisal techniques) and output of the study through field training over a period of one month. During fieldwork, two local NGOs and six community leaders played the role of community guides. Interactions were conducted mainly with household members who faced climatic shocks directly or indirectly in the last five years, older people of both sexes who could describe climatic and related changes over the last 40 years, community leaders like Self Help Group leaders, school teachers, political and religious leaders, local doctors, and grass root village health workers, local clubs and activists working with environmental issues, Panchayat (local administrative unit) members and local media personnel.

The profile of the researcher, an outsider from Kolkata, created connections as well as disconnections based on social equations with the villagers. The research assistants, a single male and a young female from Kolkata who had already been working in the Sundarbans for two years prior to the research, had a different level of acceptability among female respondents and male gatekeepers. The lead female researcher had established a good rapport with the women villagers after few visits. The female respondents were very comfortable talking to her, as they could relate to her as a single mother with a small child and migrated husband. The young female research assistant also mingled with the female villagers as most of the respondents were comfortable with her very young age. The male research assistant had to face a different dynamic as he was not able to spend time talking to women villagers and respondents due to existing patriarchal norms. However, he got much more access to the male respondents than his female colleagues due to being a man and being eldest of the research team. In the end the composition of the team balanced each other to capture villagers' perspectives irrespective of their gender. Furthermore the respondents' perception of the community guides, particularly the local NGO who 'introduced' the researchers may have also shaped the manner and shade of their responses, more so, in the politically polarised islands of the Sundarbans. These influences on the research were handled by being open about their possible consequences and

addressing them directly with respondents as a basis of relationship and trust building. While being introduced by the local NGO, emphasis was laid on the point that IIMR is an independent organisation with long standing work in the region. In addition, daily debriefing sessions with the researchers helped contrast investigators' perceptions and experiences during immersion. Fortnightly debriefing sessions with the respondents were carried out by the research assistants through group discussions. Those discussions were more informal and a notable feature of these sessions was reflection on the cultural and social practices related to climatic and environmental issues and their underlying linkages with uncertainties.

Ethnographic observation was conducted concurrently with interviews in 60 households (30 each in two villages) with a semi-structured questionnaire. Participants were recruited through community guides, including NGO workers (n = 3) and community leaders (n = 4), identified during ethnographic field work. The key aspects addressed by Focused Group Discussions (FGD) included the community's perceptions of the people's perception of changing weather patterns, impact of climate change on livelihood, health and alternative coping mechanisms including migration. Their future plan regarding Sundarbans was also discussed.

Two participatory rural appraisal techniques –seasonal calendar and hazard-vulnerability-capacity mapping –were also done as visual means of enabling respondents to construct and analyse their own uncertainty contexts. The seasonal calendar was applied to analyse the seasonality of climate impacts, occurrence of illnesses and disease and male and female livelihood strategies. The calendar helps to highlight the relation between certain climate impacts on livelihood strategies (e.g. increased male migration in the dry months) and health (e.g. increased diarrhoea in the rainy season). The data were triangulated with findings from ethnographic data on general climate change impact and related consequences.

The other participatory tool (hazard-vulnerability-capacity-mapping) was conducted with the same set of respondents in the two villages with the aim of understanding people's vulnerabilities to periodic climatic shocks, level of the impact on livelihood, health and embankments and their coping capacity and mechanism to restrain the shocks. The data were again triangulated with ethnographic findings.

The applicability of these methods to this study lies in the fact that the participants themselves played a crucial role in providing the information in the socio-economic and climatically vulnerable Sundarbans and reflected local realities and needs in the large inaccessible and climate uncertain terrain. These embedded tools for participatory observation and analysis were at the centre of research processes in the study, whilst the researcher took the position of an observer. In these processes the traditional power dichotomy is reversed and the people who are in most other studies regarded as research objects, become the subjects and agents throughout the different stages of information gathering and analysis in this study.

2.2.3. Key Informant Interviews with the 'Middle'

The second phase of data collection was in-depth interviews with the 'Middle' of the Sundarbans, including NGOs/ CBOs, journalists, long term activists and community leaders. For the purpose of the present research, in-depth interviews with a cross section of these 'Middle' were conducted across the Sundarbans. The in-depth discussions revolved round their perceptions regarding climatic changes and related uncertainties, their position on the wider climate change debate around the Sundarbans and how they perceive themselves as key players within this debate. The participants were identified by snowballing during the interfaces with local people in the Sundarbans at the time of ethnographic field work. The 'Middle' in Sundarbans is a varied mix of actors whose perceptions and actions can be influenced by the 'Above'. See Annex for the details.

2.2.4. Key Informant Interviews with the 'Above'

The 'Above' in the Sundarbans consists of government departments, scientists working in universities and donor agencies funding different developmental projects. The respondents were identified through a participatory appraisal technique called participatory impact pathway assessment (PIPA) at the beginning of the study. This was based on the previous knowledge of the researchers and knowledge gathered through secondary sources such as government and non-government reports, journals, newspaper articles. In-depth discussions were done with the 'Above' regarding their perceptions on climate change in Sundarbans and accompanying uncertainties. The discussion also centred on the future of the five million islanders living in the Sundarbans and their thoughts for possible and feasible mitigation strategies. See Annex for details.

2.3. Data Analysis

Framework analysis, a policy research-oriented analytic approach (Ritchie and Lewis 2003), guided the qualitative analysis of the data. After field data collection data from ethnographic field diaries, semi-structured interviews and in-depth interviews was indexed to develop a matrix of climate change perception and related uncertainties. Following the matrix that evolved from combining information from the differential perceptions of the different actors, the transcripts were coded in the following categories:

1. perceptions and experiences around uncertainties of livelihood, health and shelter
2. coping strategies for uncertainties
3. agenda setting for action
4. actual practices
5. future planning
6. alternative pathways

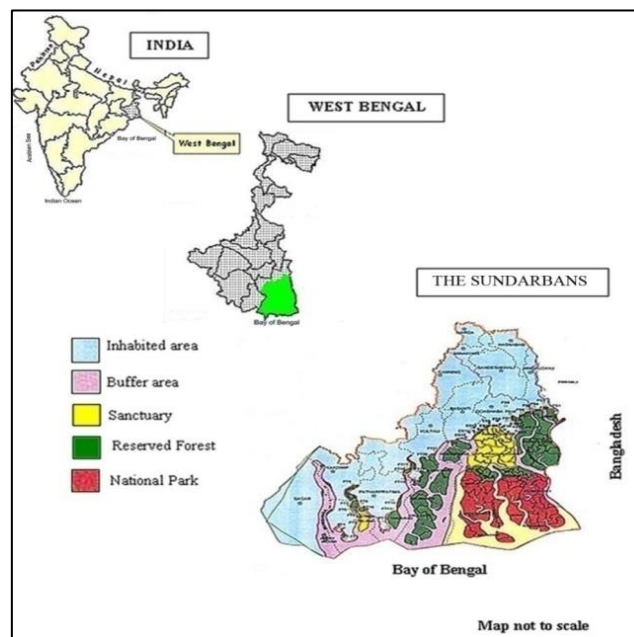
3. The Sundarbans

3.1. Sundarbans: the 'Beautiful Forest'

The Sundarbans, literally 'beautiful forest' (Jalais 2010) in Bengali, the world's largest mangrove delta, is spread over the southern end of both West Bengal (India) and Bangladesh. Recently, the area has gained prominence not only as a United Nations Educational, Scientific and Cultural Organization (UNESCO) heritage site or the largest remaining natural habitat of the Bengal tiger, but also through being one of the victims of worldwide climate change and related uncertainties.

The ecosystem that forms the Sundarbans is both fragile and unique. Its uniqueness comprises extensive mangrove forests, regular mixing of freshwater and seawater and a multicultural populace. The region is further unique, because of the mangroves that present a natural barrier against coastal erosion and seawater doorway. The inhabitants of the Sundarbans, mainly migrants from other districts (mainly Midnapur) of West Bengal and neighbouring Bangladesh, came to the islands in the colonial era and settled by clearing the jungle. Since their arrival about two centuries ago they have largely survived through fishing and mono-cropping (mainly paddy and vegetables).

Figure 3.1: Position of Sundarbans India



(Source: Kanjilal *et al.* 2013)

The Sundarbans comprise an area of 40,000sq km that includes water, forested islands reserved for the Bengal tiger, inhabited islands, cultivable land. It is partly connected to the mainland. The whole land mass can be divided into two types of inhabited islands. First, land close to the mainland which was deforested and cultivated by the first settlers and second, islands near the mangrove forest which have been inhabited and cultivated more recently. These two geographically distinct areas comprise respectively, the north-western part and the southern part of the Sundarbans. The north-western area is geomorphologically more stable, it is higher and therefore less exposed to the storms and tidal inundations than the southern area. It has fertile soil and a sweet water canal irrigation system and is also closer to the State Capital city, Kolkata, than its southern neighbour. Conversely, the southern area is less stable and more susceptible to environmental and geomorphological changes. This area is highly erosion prone, and to protect the land 3500 kilometres of earthen embankments have been built.

Most of this southern area is mono-cropic (one crop in a year) due to lack of fresh water. It suffers from land loss due to erosion, there is frequent breaching of embankments with the related loss of houses and cultivable land. Over the past 20 years four islands from this southern part of the Sundarbans have disappeared into the sea, resulting in 6000 climatic displaced people (Mukhopadhyay 2009).

3.2. People of Sundarbans: Demography

The inhabited area of Sundarbans comprises 54 islands with a dense population of about five million people (Government of India 2011) spread over 19 administrative blocks. They face challenges of poverty, marginalisation and an acute struggle against geo-climatic events. The multi-religious population mainly subsist on agriculture, fishing, and collecting forest products such as wood and honey. The complex topography of rivers, creeks and estuaries, coupled with poor road infrastructure, is a constraint on access to the area. The situation is even more challenging in the remote islands where people have to use multiple modes of transportation. As expected, the difficulties of moving between the islands rise sharply during the monsoon.

According to the 2011 Census, the total population of the Sundarbans grew by almost 18 percent in the last decade, marginally lower than the previous decade (19.1 percent), with a higher rate in the southern area than the north-western. This is a higher growth rate than the state (14 percent). Over the last two decades the growth rate of children (0–6 years) was negative. However, in the present decade (2001–2011), the growth rate is five times lower than the previous decade. Again the fall is greatest in north-western area. It is higher for male children than female children. According to the 2011 Census, the sex ratio was 955 females per 1000 males, higher than that of both West Bengal State (950) and India (933).

In the last decade the working population grew by around 28 percent, almost half that of the previous decade. The Census figures for 2001–2010 show an average workforce participation rate of 32 percent. According to the 2011 Census male participation in the workforce is higher than female participation. The workforce composition, divided among main and marginal workforce, shows that around 69.7 and 59.4 percent of the population belonged to the main work force in both the census years, while 30.3 and 40.58 percent belonged to marginal group in 2001 and 2011 respectively.

The inhabitants of the Sundarbans were historically marginalised groups such as forest collectors, fishermen and landless peasants who were not living in the Sundarbans by their own wish. From the beginning people were subjected to abject poverty and deprivation. Due to continuous geographical challenges they have had to struggle for survival. Their dependency on rain-fed mono-cropic agriculture, and on a collecting and gathering economy from forests and rivers, have always made them subject to chronic poverty. One reason may be that nearly half of the population (47 per cent: 2001 Census) belongs to historically marginalised groups such as the Schedule caste and Schedule tribes, while over half (55 per cent: 2001 Census) of the farming communities are share croppers, landless laborers or tenant cultivators. Another reason is a poor physical infrastructure and a lack of transport and communication. Most of the islands are connected by river transport, though this is infrequent which can make travel difficult. The mainland area, however, has a road and rail network, much of which becomes inaccessible in the monsoon season. Physical inaccessibility precludes a large part of the southern area having a conventional electric supply. Education is one area which is ahead of the State average. Globalisation has had an impact on the people of Sundarbans, as can be seen by their use of mobile phone, television, and packaged food and drinks. The people of the Sundarbans thus face a combination of poverty, marginalisation, commercialisation, as well as having strong dependency on natural resources.

3.3. People of Sundarbans: History

Early mention of the Sundarbans date back to the *puranas* (Sarkar 2011). The Sundarbans came to prominence due to the infamous pirates, mainly of Burmese and Portuguese origin, who were familiar in this region. Historical literature mentions the existence of the Sagar islands with a population of close to 1.5 million people who respected the temple of a famous sage (Sarkar 2011).

The British, through the East India Company, were given the lease (*Dewani*) of Bengal, Bihar and Orissa in 1765. Soon after, in 1785, they leased out small portions of the islands of Sundarbans (Lots) to *zamindars* (Landlords from nearby places) for 99 years. The *zamindars* first brought in different ethnic groups from Bihar, mainly used to build earthen embankments. Many came from neighbouring district of Midnapur as they were the labourers of the *zamindars*. Post-independence, a sizeable portion of the Hindu population migrated to the Sundarbans from neighbouring districts of Bangladesh as a result of the partition.

Like most of the other regions in India, the socio-cultural milieu of Sundarbans also stemmed from its material culture developed to harness the nature. According to Jalais, the ethnic composition of the Sundarbans is a mix of four major groups (Jalais 2010). These are: first, tribal communities, mainly Oraon and Munda relocated from Chhoto Nagpur plateau as bonded labour to clear the forest during colonisation; second, people from *Midnapur* district, designated as OBC population. These formed the top layer of the stratum because of their education and agro-based livelihood. They mainly relocated in the Sundarbans after the 1943 Bengal Famine struck in the areas in which they used to live. Third, the mainly Muslims immigrants from the neighbouring country of Bangladesh and other parts of the mainland of West Bengal. This group are mainly engaged in forest based economy and deep sea fishing. The fourth group consist of the Hindu Bangladeshi immigrants who had relocated as refugees from East Pakistan during 1970s. This particular group mainly depends on agro-fishing economy and continue to maintain a continuous tension with the *Midnapuries*. Today these divisions can also be seen in the different types of folklore and folk music, and religious beliefs and customs. Endogamy is also still maintained on the whole. Upward social mobility in these four groups is increased by the spread of ideas from the city of Kolkata, the widespread use of information technologies such as cell phones and satellite TVs, and the transformation of livelihoods from the traditional agro-fishing economy towards wage related jobs.

The history of political neglect of the Sundarbans started in colonial times when colonial rulers realised that if reclaimed they could yield revenues, especially from the forests. Forest protection laws were passed in early 1876 (Chakrabarty 2009) and since then the nature harnessing communities, the main users of the forest, have been facing regulation on their use of forests. The alluvial cultivable lands and villages formed about 1793 were kept outside the Jurisdiction of Permanent Settlement⁴ (Chakrabarty 2009) by the colonial rulers. These regions were highly fertile and were the source of supplying food grains during the Nineteenth Century famine of Bengal (Iqbal 2006). The region had the potential to accommodate people suffering uncertainties such as economic stress, natural calamities and clashes (Chakrabarty 2009). The regions welcomed several immigrant communities including the Magh pirates of Arakans. The Sundarbans' hospitable nature influenced revolutionists Sir Daniel McKinnon Hamilton⁵ and Joytirindranath Mukherjee⁶ to form utopian settlements in the region where all the 'neglected' would be equal.

A similar tale of neglect in the post-colonial period was seen with the launch of Project in Tiger in 1973 and implementation of the Sundarbans Biosphere Reserve Programme. Project Tiger was a local part

⁴ A land revenue arrangement of the colonial rulers.

⁵ A Scottish visionary of Colonial India.

⁶ An Indian revolutionary activist against the colonial rule.

of global ecology and environment protection politics in the post-World War II era. The Sundarbans was one of the nine forest reserves for tiger conservation under the 1972 Wild Life Protection Act. Global environmental players now entered into the Indian environmental scene, among them the World Wild Life Fund (WWF) was prominent (Chakrabarty 2009). According to Chakrabarty, 'the Sundarbans thus became local theatre for a larger universal campaign informed by the science and politics of international capitalism' (Chakrabarty 2009). This resulted in many villagers being displaced from buffer zones of the forest reserves resulting in clashes between forest guards and local people. The knowledge of the indigenous population on how to conserve their land and manage their neighbour, the Royal Bengal tiger, is still not taken into account in policy making or the implementation of these policies. Policies of both colonial and post-colonial periods have fuelled the marginalisation of local people by neglecting their needs and a refusal to listen to their voices on how to handle the uncertainties of the Sundarbans (Jalais 2010; Chakrabarty 2009; Mukhopadhyaya 2009).

3.4. Bonbibi: the Goddess of Syncretism

Bonbibi, the goddess of the jungle is worshipped by all islanders irrespective of their caste, creed and religion in the Sundarbans. Legislation passed in 1970s allows the islanders who depend on the forest products are allowed to go to the jungle twice a year. *Bonbibi* is worshiped by chanting from the *Bonbibijoburanamah*.⁷ According to the *Bonbibijoburanamah* *Bonbibi* has Islamic roots. She was asked by Allah to protect the islanders from tiger attack. Tigers in the Sundarban jungles are ruled by a male deity called *Dakhsin Rai*, a Hindu sage who can take the form of tiger. After receiving the call from Allah, *Bonbibi* went to Mecca and brought holy soil to mix with the soil of the Sundarbans, whereupon *Dakhsin Rai* declared war against led by his mother *Narayani*. Eventually *Narayani* became friendly with *Bonbibi*, the fighting ended and *Dakhsin Rai* accepted *Bonbibi* as his mother. *Bonbibi* then asked all the humans and non-humans in the jungle to take care of each other and create a brotherhood. Her door (the jungle) is always open to everybody who comes with a clear soul and who can take care of others' needs.

The story of *Bonbibi* clearly expresses early conflicts between the Hindu and Muslim islanders over the forest resources and how these were resolved. It reflects how two different faiths developed syncretic traditions to survive and co-exist with the forest. Thus the story of *Bonbibi*, 'by treating the jungle as a "commons" ' (Jalais 2010) was successful in superseding the boundaries of religions and castes and make the Sundarbans a place of cultural syncretism. While the Sundarbans as a region has a marginalised status in terms of history, geography and climate, it also is an area of striking cultural and religious syncretism. As the following Sections show it is striking for its struggle for existence through indigenous coping strategies.

⁷ *Bonbibijoburanama* is a holy script which describes kind acts of the Goddess *Bonbibi*.

4. Climate Change in Sundarbans: Glimpses from the Literature

4.1. Climate Change Trends

From the very beginning of human settlement, the Sundarbans' islanders have had to contend with climatic shocks like cyclones, and rivers changing their courses (Samsuddin 2012). The first of the recorded climate shocks occurred in 1582 and has been termed as a 'super cyclone' (Samsuddin 2012). Another notable change is the natural outflow of the water from the Ganges to the Padma in Bangladesh which is a prime cause of the increased salinity of the river systems in India. Scientists have maintained that the changes were mostly natural in origin till the 1950s (Sarkar 2011). In later years localised changes in the temperature and erosion rates have been affected considerably by human action such as the cutting down of mangroves and forest for settlement. Additionally the growing use of mechanised boats, heavy machinery and infrastructural development made the already volatile geomorphology more unpredictable. Among the latter, the most significant is obviously the construction of Farakka Dam in 1975 in the District of Mushirdabad. According to eminent River scientist Dr Kalyan Rudra, the accumulation of silts in Kolkata port increased four times between 1999 and 2003 after the commission of the Farakka Dam. Greater amount of silts are accumulating upstream of the Farakka Dam, while the downstream, water from Farakka Dam is less silt laden and thus causing more erosion. As the Sundarbans (both the Indian and Bangladesh Sundarbans) are situated at the sea mouth of the Ganga-Brahmaputra-Meghna delta (i.e. downstream from the Farakka Dam) they are facing the maximum erosion (Rudra 2008). This, combined with sea level rises due to worldwide climate change has a crucial impact on the rapid land erosion in the Sundarbans (Rudra 2008; SANDRP 2014a; SANDRP 2014b).

In recent years there is growing scientific evidence (IPCC 2015; Hazra *et al.* 2010; Danda 2011, CSE 2012; Government of West Bengal 2010) that the Sundarbans are facing climate changes in the last four decades. These are profoundly affecting the lands, homes and livelihoods of the local communities, especially those living in the island pockets (Danda 2011). These changes manifest themselves in changes to the temperature and rainfall (e.g. longer summers, shorter winters, erratic rainfall), as well as sea level rises, coastal erosion and an increasing frequency of cyclonic events (Danda 2011). Many islands, especially those which are closer to the sea, are more prone to sea level rises than the global average (Danda 2011, Hazra *et al.* 2010). Scientific analysis has also shown that climate change induced rise in sea levels has resulted in the depletion of land in 11 islands in the Sundarbans (Hazra *et al.* 2010; CSE 2012). There are yearly shocks of pre-monsoon cyclones and floods that damage habitations leading to difficult economic consequences, especially on natural resource dependent households (Mitra *et al.*, 2009; Danda 2011).

Hazra *et al.* (2010) traced the temperature changes in both Bay of Bengal and the Sundarbans during the decade of 1990s and observed a rise of 0.019 degrees air temperature over both land and sea. The same study found that if temperature increase continued with same degree of increment, it may increase up to one degree by the middle of the present decade (Hazra *et al.* 2010).

Scholars have also noted that the sea surface temperature (SST) in the Bay of Bengal has increased by around half a degree Celsius per decade, mainly in the eastern part of the Sundarbans since 1980 (Singh 2010; CSE 2012). According to a joint study carried out by the Massachusetts Institute of Technologies and the University of Calcutta in 2009, the average SST has increased about one degree Celsius in last two decades, especially during pre-monsoon periods (Mitra *et al.* 2009). The same study also found that the SST during pre-monsoon, monsoon and winter is significantly higher now than it was in earlier decades, which had an significant impact on the hydrological system of the region (Jadhav and Munot 2009; CSE 2012).

The studies on rain fall patterns in the Sundarbans during last two decades show an increase in the Sundarbans (Hazra *et al.* 2002; Hazra *et al.* 2010). According to Hazra *et al.* (2002 and 2010), the annual rainfall in Sundarbans averages 162mm, with 2000 mm in high rainfall years and 1300mm low rainfall years. However, two studies by Indian Meteorological Department (IMD) in 2007 and 2009 (Singh 2007; Jadhav and Munot 2009) observed that rain-bearing low-pressure systems exhibit no significant changes and stayed longer without culminating in rainfall. IMD studies predicted that rises in the SST prevent the formation of the low-pressure systems causing the rain (Jadhav and Munot 2009). This leads to drier monsoon with more intense stand-alone incidence of rains. The idea of drier monsoons with high intensity rain fall was also supported by Hazra *et al.*'s study in 2010.

Hazra *et al.* in 2002 showed that the relative mean sea level in the southern part of the Sundarbans (near Sagar Island) is rising by 3.14mm/year (higher than the global average of 0.5 to 3mm/year). The research showed that by 2050 there could be a rise of 20cm. This would lead to the submergence of vast areas of the Sundarbans which had already lost 97.16 sq km of land in the southern part of the delta (Hazra *et al.* 2002 and 2010). In a more recent study carried out by the Jadavpur Oceanographic Department and the World Wide Fund for Nature in 2011 it was shown that active delta land erosion is a natural phenomenon in Sundarbans but the rate of erosion is higher than the accretions rate. The study estimated that about 69,000 people from the different islands of the Southern Sundarbans have been displaced. The study also projected that by 2020 more than 1.3 million people from different part of the Sundarbans will be displaced by the sea level rise and respective coastal erosion (Hazra *et al.* 2002; Danda 2011).

Work of Singh (2001) revealed that there has been a 26 per cent increase in the severe to moderate category of cyclone over the Bay of Bengal in last 120 years (CSE 2012). Similarly, a 2010 study from the School of Oceanographic Study, Jadavpur University showed the magnitude of cyclonic events became more intense between 1970 and 2000. Pre- and post-monsoon storms were found to be more violent than the storms of the monsoon season.

4.2. Cyclone Aila as a Key Event

After cyclone Aila struck the Sundarbans in 2009, climate change became mainstream in wider development debates concerning the Sundarbans. The 2011 State Action Plan on Climate Change (SAPCC) acknowledged that this cyclone established that the southern coast of West Bengal is highly vulnerable to storm surges and cyclones (Government of West Bengal (2010) and that climate change impacted on inland fisheries, agriculture and water resources. Other studies show cyclone Aila in 2009 and cyclone Cidr in 2007 were caused by the changing climate of the Bay of Bengal region (Alam *et al.* 2011; Kabir 2014; Kabir *et al.* 2016). Severe to moderate cyclones, such as Aila and Cidr, have been highlighted by some scholars part of climate change impact. This reasoning is greatly influenced by global aid and resource politics (Grant, 2015). In case of the Indian Sundarbans, cyclone Aila supported the arguments of natural scientists researching climate change impact on the Sundarbans (Hazra *et al.* 2010; Danda 2011) highlighting the problems of environmental degradation and changing climate. The scientists projected more damage and devastation in terms of sea level rise, related storm surges and the sinking of a major part of the delta in future years, and the proposed planned evacuations of the population from the region to nearby towns and the city of Kolkata (Hazra *et al.* 2010; Danda 2011). Climate change in the Sundarbans, however, was not reflected in the work of other West Bengali natural scientists who saw cyclone Aila as a natural hydro-meteorological event, and the damage caused due to lack of socio-technical capacity of the population and state to combat disaster (Rudra 2010). Stress has also been given to the normal geomorphological process of the delta and its impact on land erosion, breaching of embankments and the preparedness, or otherwise, for natural disasters (Rudra 2010). According to this school of thought the Sundarbans do not need foreign support to protect them from frequent disasters, but rather local people's indigenous knowledge, resources and labour are enough to reduce pressures on embankments and related damages (Rudra

2010). The necessity of strengthening institutional arrangements and sustainable planning, so that people can maintain their life and livelihood within the island, is stressed (Rudra 2010).

After cyclone Aila in 2009 other players such as NGOs and CBOs started to provide services such as health, education and disaster-risk reduction. Most of them started as local voluntary organisations, but after 2009 international agencies became more prominent. This has led to the reduction of representation of the local population. Most of the agencies have a top-down awareness of climate change, which has made the implementation of their programmes donor driven. In recent times many organisations are being shut down due to the withdrawal of funding. This will be discussed in greater detail later.

To summarise, cyclone Aila was an event which, according to Mukhopadhyay (2011), '*marginalizes the marginalized*'. The people of Sundarbans were marginalised from the beginning of their settlement during colonial period and this is still continuing through different forest policies. Cyclone Aila was an event which pushed back the already marginalised population of Sundarbans into yet more economic marginalisation. It is also embedded in claiming special status for Sundarbans as bio-reserve for the tigers and the mangroves; not for the people who are already living at the fringes of the state of West Bengal. Mukhopadhyay (2009) pointed out the whole debate of climate change, environmental degradation, biodiversity conservation and anthropogenic exploitations are the result of a continuous tug of war between the local people wanting to harnessing natural resources for livelihood and the state wanting to limit them for the sake of natural conservation (Mukhopadhyay 2009; 2010). Cyclone Aila added to the problems of both sides, neither of which were ready to handle the stresses that ensued. As will be shown in later Sections, different actors with their own dominant pathways and narratives are in a continuous tension with each other. They reflect their own power dynamics, occasionally aligning with one or another. Within this conundrum of strong political and economic interests, local people's own narratives about their vulnerabilities and experience of dealing with the changing climate are often lost. It is thus important to focus on how the islanders are managing with the environmental and climatic odds that they constantly encounter and whether or not they can and have developed alternative pathways building on their material culture and folklore. We now turn to explore these issues around the areas of livelihoods, health and shelter.

5. Sustaining Livelihoods Amidst Climate Change Related Uncertainties and their Interactions with Other Drivers of Change

The Sundarbans has always been a land of natural resource based livelihoods without the option of industrial development, limiting the choices for the local population. The complex interplay of climatic changes along with changing market forces and globalisation has led to growing livelihood uncertainties in the Sundarbans in last two decades. The islanders of the Sundarbans have to face both visible and not-so-visible uncertainties in their traditional livelihoods like agriculture and fishing. The immediate uncertainty of a visible and sudden climatic shock, such as flood or cyclone (a frequent occurrence in the Sundarbans), is often a sudden rise in the water level and a related breaching of earthen embankments, inundation of homesteads and agricultural land and salinity intrusion in land and water. As a result, significant loss in the agriculture production and in fish-catch has to be faced by the islander which leads to household food insecurity and economic instability of the islanders' this results in migration of men, mostly to neighbouring states such as Kerala for alternative employment. Consequently, women-headed households are emerging where women have to take care of the supplemental livelihoods, household chores and child care. Women are more likely to become part of the marginal workforce as unskilled labour in the handicraft sector and risky options like crab catching.

5.1. Agriculture and Food Security

In discussions in a participatory rural appraisal technique (a seasonal calendar – see Table 5.1) women respondents who have seasonal migrant husbands clearly showed the relationship between seasonal variation, livelihood strategies, food security and accessibility of available resources. The main objective of the seasonal calendar was to analyse the seasonality of climate impacts, occurrence of illnesses and disease, and male and female livelihood strategies.

According to the women respondents their husbands generally migrated May to July and October to December. During the rest of the year they engage in agricultural activities and other unskilled alternative livelihood options such as embroidery and local casual work. However, during June to August, the usual rainy season, households have few livelihood choices. The effect of frequent heavy showers, storms and areas of waterlogging makes access to agricultural land difficult and casual work less available. Roads and waterways are also affected during the monsoon season. With the advent of bad weather in April people start to have to restore damage to their households thus losing most of their cash savings. Food that have been stored throughout the year becomes scarce due to the loss of garden vegetables as a result of storms. Household food security also diminishes during the monsoon season as links to markets and fishing opportunities become risky and costly.

Looking at whether people perceive their experiences as due to climate change not, most of the respondents see climate change as synonymous to changes in the weather pattern leading to changes in the crop pattern. According to them, previously rain water acted as a fertilizer which naturally helps in plant growth. But now they have to supply huge quantity of fertilizer to grow the plants. At the time of cyclone Aila most of the respondents lost productivity of agricultural land due to salinity ingress and, 'at least five to six years would be needed to regain the productivity', stated one middle aged male respondent from Study Village Two. Though the agricultural land of the Sundarbans always had a mono-cropic production cycle, after cyclone Aila this cycle was breached. Continuous salinity intrusion made the agricultural lands waterlogged. See Figure 5.1.

Table 5.1: Seasonal Calendar: a participatory rural appraisal tool

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Weather												
Flood						***	***	***	***			
Storm				**	***	***	**	*	*			
Livelihood strategies												
Migration (men)					**	****	**** *			****	***	**
Agri/daily labor	***	***	***	***	***			**	***	***	***	***
Fishing (women)							**	**		**	**	
Access to Transport (not accessible)												
Road						****	**** *	***				
Waterways				***	***	****	**** *	***				
Household Assets												
Food	***	***	***							***	***	***
Cash		***	***						***	***		
Illnesses/disease												
Diarrhea						***	***	***	**			
Fever	**	**	**			**	**	**			**	**
Dysentery			**	**	***	***	**	**				
Cough and cold	***	***	**	*	**	**	**	*	*		*	**
Skin rashes		*	***	**	**							
ARI	***	**										**

The ethnographic field work reveals ground level narratives stating the uncertainties faced by the islanders such as the female respondent of Study Village One who was a victim of the 2011 massive flood in her village. The islanders are habituated in periodic inundations of water during high tides, as the region is low lying, however, during the monsoon sudden floods can erode away the usual contingency planning. The following narrative of a female respondent from Study Village One paints a picture of such sudden events:

As we all have experience of seasonal flooding, we could react rapidly and collect some necessary goods and store those on a scaffold within the room. Then we all went up on the scaffold and waited for morning to come – but by that time the water had gradually started to enter our house. We all thought it would go down in the morning as always happens during seasonal flooding. But in the morning we realized how wrong we were. The water level rose to touch the bottom of our scaffold.

Woman respondent, Study village One

Figure 5.1: Waterlogged Agricultural Lands after Cyclone Aila due to Saline Water Intrusion from the Sea



Source: IIHMR

Although the people are used to the seasonal flooding in this area and had been greatly affected by cyclone Aila, they could not understand that most of them would lose much more than was usual this time in 2011. How much the flood has impacted the livelihood of the islanders is reflected in the narrative of the following woman respondent a 45 year old wage labourer with three daughters and a son. They had gathered money for the marriage of the elder daughter bit by bit over the last two three years. This sudden flood upset all their plans:

This all-devouring flood sent away my two daughters. I had to send my daughters, who are only 15 and 16 years old, to Kolkata to work as maidservants in big houses. They had never been anywhere outside the village, but fortune took them to the deep directly.
A middle-aged woman respondent from Village Two

After the flood her husband had to migrate to Kolkata. But soon they realised it was not possible to collect the remaining money for their elder daughter's wedding within a year or two:

My elder daughter has reached the age of marriage. We have to marry her off within a year or two. We had no option but to send her to work as house maid in Kolkata. We also sent our second daughter with her for the same job because we need the money as soon as possible. After two years when they return with the required money we will arrange her marriage.
A middle-aged woman respondent from Village Two (as above)

These narratives describe some regular experiences of people living in the region. It is evident that direct loss is not the only outcome of environmental emergencies in their lives – the uncertainty is overarching.

In the Indian Sundarbans climate variables, such as rain which is now more or less unpredictable and erratic, have resulted in adversely affecting the most stable and traditional livelihood, agriculture. People's observations of erratic and untimely intense rain are similar to the scientific prediction by the scholars (Hazra *et al.* 2010; CSE 2012).

'Farming was our main livelihood. But as the rainfall is so unpredictable now, we cannot depend solely on agriculture. During non-agricultural season, I work as a wage labour even though I am in my 50s', stated a male respondent of Study Village Two.

Furthermore, the region has to face periodic flooding almost every year, especially in the late monsoon period. Farmers are mostly dependent on rainfall, as in places ground water is saline. Salinity

increases in the years of inundation. They may have high income and yields during ideal precipitation years but income and yields plummet when the rainfall is too high (floods) or too low. Moreover, rainfall has shifted to the post-monsoon period. This has harsh implications for agricultural productivity. Any change in the rainfall pattern means that the rains do not come when the seeds are sown, they come when the harvest is to be reaped. As a result, a large percentage of the standing crop is lost. And since most of the farmers in the Sundarbans are single crop farmers, this means a direct loss of livelihood and threat to food security.

Box 5.1: Hazard-Vulnerability and Capacity Assessment

During the PRA technique hazard–vulnerability-capacity assessment which indicates climate-related risks in people’s lives and livelihoods the mixed group respondents were asked to ranked climatic events according to the level of impact they have on people’s lives and current coping mechanisms that have been addressed in order to fight back the uncertainties. During the discussion participants were asked to rate their vulnerabilities and capacities to cope with the changing climate and recurrent shocks. They were asked to give a number out of 10 according to severity to the most frequent hazards in different dimensions of the shocks.

		Heavy Rain	Cyclone
LIVELIHOOD	Level of shock	4	5
	Impact	Sea level rises, saline waters intrusion into the freshwater system, crop loss, loss of sweet water fishing, loss of livestock.	Coastal erosion, Intrusion of saline water, life risk for deep sea fisherman, crop loss.
	Coping mechanism	Migration to cities, selling household assets, cultivate salinity resistant crop, borrowing money from money lender.	Migration, wage labor.
HEALTH	Level of shock	4	5
	Impacts	Water borne diseases (especially in women and child), coughs and colds.	Water borne diseases, fever, cold, malnutrition.
	Coping mechanism	Dependent on RMP, in very few cases they seek help to the ANM.	Dependent on RMP and traditional healer, fewer times to the PHC, SC, Private clinics.
EMBANKMENTS & SETTLEMENTS	Level of shock	3	4
	Impacts	Mud houses collapse, land and water transportation cut off, breaching of earthen embankments.	House damaged, breaching of embankments.
	Coping mechanism	Building of concrete houses, preparing crude embankments.	Building of concrete houses, preparing crude embankments.

During my father’s time we were able to assess the weather and predict the impact. Now you cannot simply assess the weather change. Particularly in the last decade the variation in season is very striking. Due to unpredictable delayed rainfall we face huge loss of standing crops.

A middle aged farmer respondent from Study Village One

As a coping strategy the farmers also undergo certain 'mal-adaptation' by borrowing money from local moneylenders in attempt to regain the loss. This attempt sometimes pushes them into a vicious cycle of indebtedness which in turn could make them more vulnerable to any further climatic or non-climatic shocks like the health or education. Recently, farmers with the help of different Government and non-Government scientific organisations are trying to adopt salinity-resistant traditional crop variety for better production. There are also trends towards other cash crops such as vegetables and

cotton had always been on the sustainability agenda of the Sundarbans Development Board. Another farmer recounted how he lost his livelihood during an inundation in the previous year:

I have to give one bigha of land on lease for Rs 5,000/- after last year's flood. I used that money to buy a cow which then had a calf. We got six to seven litres of milk a day (together), some of which we sold. After the water turned down my daughter-in-law had come back with two small children, so we do need some milk at home. We rebuilt our house again alongside the banks of the river with the help of a local NGO. They provided all the raw materials and we provided all the labour. But it was though very difficult to maintain so many people with very little money. After much deliberation I took a loan from the Mahajan and had just bought another cow, which gives about four litres of milk a day. Now we sell two litres of milk daily to a private dairy at Rs 10/litre, in which pay is not regular. Still it became very difficult for me to arrange the living for the whole family. Then I had to take off my two young children from school.

A farmer respondent

5.2 .Fishing

Fishing has been perhaps the most common and staple livelihood options for the people of Sundarbans since their habitation of the area. It has not only provided livelihoods to the households but also provided protein in the diet of the islanders. The people of the Sundarbans have traditionally been fishers in terms of skill and culture. One of the traditional inland fishing techniques, '*meendhar*', (prawn seed collection) was synonymously associated with the women fishers of the Sundarbans. Their local belief system and social structure was also built around this livelihood option. According to the local fisher folks, the amount of fish caught in the last two decades is much less than their previous experience:

Previously we have God's blessings for catching up the fishes. It is due to the greed of the human to have more fish, thousands of trawlers have gathered here. We are not getting much fish in peripheral zones now. We have to go either into the deep sea which is a costly affair or we have to go to the deep into the reserve forest where risk of tiger attack is very high.

A fisherman respondent from Study Village Two

One of the reasons they see behind the declining fish catch is a combination of climatic and other market related factors. According to them fishing is now a professional activity rather than a traditional one. The fisher respondents stated that the amount of fishes had been declining to a large extent in last two decades near the coast. Their experience and observation corresponds with the scientific explanation given by researchers (Hazra *et al.* 2010; Danda 2011), that a rising sea surface temperature is impacting on the coastal marine life and forcing the species to move into the deep sea. The respondents also stated that in recent years intrusion of highly mechanised trawlers, which leave chemical pollutants in the water, has increased. This leads to inferior quality of river water and the disappearance of fish species. These trawlers mainly catch the fish of the entire area with large mesh nets and after catching them they only take the large fish and throw away all the smaller ones. Hence this is ultimately causing the death of spawns and is also a huge loss to marine biodiversity. However, there are other reasons attributable to this, such as deep sea trawlers violating territorial waters, increasing salinity in the water and increasing roughness in the sea mouth.

A declining fish catch and increasing operational cost make conditions difficult for the fishermen in the Sundarbans to stick to this once most viable livelihood option. Available credit facilities in the fish market are now also declining which put the fishers in great difficulties with regard to maintaining operational expenses. The inland small fishing operations which were once a prominent livelihood option in the Sundarbans, are also decreasing, especially after cyclone Aila. The salinity intrusion into the fisheries has made them unsuitable for sweet water fishing, and made them unusable, especially,

for *meendhara*. *Meen* was always controversial with regard to the biodiversity of conservation in the Sundarbans, as this traditional practice threatens the conservation of marine species. According to the Biodiversity Conservation Act, prawn seed collection from the fringe of the river is now illegal. People are aware of this fact as the respective government departments have successfully executed awareness generation campaigns on how this fishing practice is hampering the ecosystem and other precautionary measures. (See Figure 5.2.) One of the woman respondents from Study Village Two, a traditional *meendhar*, described her experience while doing this 'illegal' practice:

Our only skill is to collect 'meen' which we are doing from generation after generation. Now the 'sarkar' is saying this is illegal as we are costing damage to the environment. They even spread glass pieces in the river bank for stopping us from catching the fish.
A woman respondent from Study Village Two

Figure 5.2: Meendhara - the Traditional Way of Catching Small Fish



Source: IIHMR

Most of the fishers are now opting for the alternative of crab catching which is more physically strenuous and a more risky affair because these crabs are mostly found around tiger reserve forests.

The slow and painful rebuilding of livelihoods also has other detrimental uncertainties in social relations, which can be seen in the narration of a young woman respondent.

We lived in a joint family with my uncle since my father died five years back. We used to have more land earlier, but only few fertile bighas left after last years' flood. Uncle asked my mother to make a separate arrangement for ourselves as land resources are getting meagre and he has to feed his own family of five. We started to live under a plastic sheet, given by the local NGO. My mother had to borrow money at a high rate of interest from the local Mahajan. After two months as my mother could not repay the loan in time, she had to work as housemaid from morning to night in Mahajan's house till now. I then have to take care of the household chores as my siblings are too little to handle that. I have to dropout from school as it is expensive and time consuming too under these circumstances.

A young woman respondent

Options like kitchen-garden work and livestock rearing are also facing uncertainties, as stated by the respondents. Repeated loss of lands and salinity ingression is making kitchen gardens almost impossible to sustain. According to the respondents, previously the studied islands were self-sufficient in producing their own foods and even quite famous in producing vegetables like gourds, pumpkins, okra, chilli and tomatoes. Recent climate changes and its consequences impact heavily on this viable option and has made people dependent on the market for consuming vegetables. The nearby vegetable markets are also facing losses due to shortage in production, leading to a significant increase

in vegetable prices which is beyond the reach of most of the respondents. According to the respondents it has limited their food choices.

Kitchen gardens in the island are just vanished. Some people grow something in a scattered manner, but how many days you can subsist on that? We have to buy everything from the market now for a higher price. Even the most affluent people of the island also can't buy it in daily basis.

A women respondent from Study Village Two

The eroding land and salinity ingression also make livestock rearing an uncertain option for the islanders. Due to lack of grazing land, islanders have to sell their cattle to their mainland relatives. Moreover, after a climatic emergency, cattle are the first household asset that has to be sold to restore the immediate financial impact. Previously, livestock were fed with the residual agricultural products, but the recent decline in agricultural products have made it difficult for livestock owners to maintain their flocks.

5.3. Alternative Livelihoods

In semi-structured interviews with 60 households, almost 44 households out of the 60 have stated that they are forced to take alternative livelihood options just to sustain their families due to the increasing frequency of the climatic adversities. This includes leaving the comfort of traditional livelihoods like agriculture and fishing to take up mostly unskilled option like wage labour, embroidery work, crab collection and migration out of the area. The respondents clearly stated that it is quite difficult for them to cope with this livelihood transition as, firstly, they do not have required skills to catch up with new kind of livelihood options and, secondly, there are very few options available in the Sundarbans. Hence, migration is often the most feasible way out. See Figure 5.3.

Figure 5.3: Jari Work as a Means of Alternative Employment



Source: IHMR

Most of the respondents stated they have at least one of the family member who has migrated to cities in other states, whereas other respondents' family members had migrated to nearby cities (see Figure 5.4). These migrants were mainly engaged in daily wage labour.

We are the folks of agriculture and fishing. We do not know anything else. Nobody has come forward to give us training for alternative livelihoods.

A 48 years old fisher folk respondent

Those who moved interstate reported the reason was it offered better paid employment than their own state, though there are evidences of exploitation. Large sections of the migrated population depend on the traditional means of sending money through their peers according to their availability. The supply of money therefore is often erratic. Not all migrants are willing or able to send money home regularly leading to the women, now *de facto* head of the family, falling prey to money lenders. In the aftermath of cyclone Aila respondents have stated there was a proliferation of the money lenders, who charged a high rate of interest.

Figure 5.4: Migration of Male Islanders for Alternative Livelihood Options



Source: IHMR

5.4. Coping Strategies

Respondents talked of different types of coping strategies, especially with regards to livelihoods. Farmer respondents stated that, due to degradation of grassland and low grass production after cyclone Aila, they have had to reduce the numbers of livestock. The majority of respondents reported planting salinity resistant cash crops such as cotton and a few vegetables, instead of cereal crops, with the help of the Panchayet. Households situated near the embankments manufacture their own salt from the saline soil using traditional methods. After cyclone Aila, with the increase of the salt content in the land, the low cost indigenous process of salt production has benefitted them economically and this coarse salt is in demand in the rural market.

Another interesting innovation is rain water harvesting in community ponds. After cyclone Aila, as most of the sweet water ponds were converted into saline water ponds, new small ponds were dug at the onset of the monsoon which eventually filled with rain water. Each of these community ponds were used by four to five households, with the water being used for bathing, washing, drinking water for livestock and cooking. Not many local civil society organisations are working with the community to build up the rain water harvesting process

5.5. Perceptions of the 'Middle' on Livelihood Uncertainty

The majority of the 'middle' who have stakes in livelihood issues is grassroots NGOs and CBOs. Most of them derive their identity from the Sundarbans and its people and are well placed to articulate the demands of the 'below'. Several have over 20 years of experience in working for the people of the

islands and emerged out of small neighbourhood cultural and welfare clubs with a committed band of young people. This shows they are embedded in the area and are able to understand the needs and interests of the local islanders, as well as the changing conditions of the islands over the decades. The dwindling livelihoods and the gross neglect from the state are bemoaned by most of the CBOs of the island's civil society. 'The islanders always had to live amidst the lack of services and support from the state', reported the head of a CBO in Study Village One.

While they acknowledge that climate change and cyclone Aila have severely affected the socio-economic condition of the islanders, NGOs and CBOs acknowledge the funding opportunities that came as aid after the cyclone Aila through which hospital buildings, emergency cash support for livelihood restoration programmes and other aid funded programmes arrived. However, after the funding period was over, it was difficult to continue those services. As there was no concrete plan for the sustainability of the programmes, they are now non-functional. The chief secretary of a local NGO stated:

The international agencies rushed with aid and disaster relief to partially ameliorate the sufferings of the people in the immediate aftermath of cyclone Aila. But little has been done with an eye to provide sustainable solutions that address the basic necessities of the islanders. [The 'middle' perceives it to be ironic that the same government] who runs tailor made programmes for this biggest mangrove delta in the world has not thought adequately about the welfare of over 50 million humans who reside along with the tigers and the crocodile. President of a NGO who was borne and brought up in the Sundarbans

While describing their role and action, he continued:

We know our mangrove is in danger. We are trying our best to make people aware regarding this. We publish leaflets and periodicals and conduct village level meetings widely across the Sundarbans. It is due to our constant agitation and petition in front of the local administration that they have to put some laws against the unplanned cutting of mangroves.
As above

The civil society initiatives have been adversely affected by the irregular donor funding cycles and which in most cases failed to address the core issues of sustainable growth. There has been a propensity of donor agencies to invest in building and construction or activities that are easily visible rather than on human resource development.

A section of the 'middle', especially the community leaders, CBO personnel and activists, argue that the continued absence of a comprehensive strategy to counter the effect of climate change will gradually weaken the resilience of the communities. 'Whole families would be forced to migrate. Already large number of youths has migrated in search of livelihood and the trend is on the rise', was stated by a member of a CBO.

According to respondents from this section the 'above' is not keen to incorporate suggestions of the 'middle' and nor to encourage its independent voice in public discussions, which are grounded on in-depth knowledge of the climate change manifestation in the livelihoods faced on a daily basis by the islanders. The 'above' has always viewed the 'middle' with scepticism and discouraged transformation of ideas and problems into issues for discussion in the public space. With the some rare exceptions, the 'middle' has not been able to influence public discourse on policy-related issues at local and state levels. One of the indicators may be the absence of any constructive forum for the exchange of ideas and knowledge between key players in the formulation of policy.

5.6. Perceptions of the 'Above' on Livelihood Uncertainty

Different layers of the 'above' have different standpoints concerning livelihood issues in the context of climate change in the Sundarbans. Agricultural scientists and marine scientists are concerned about the depleting agricultural and fish productivity due to the changes in the weather pattern, salinity ingress in fields and water and unpredicted rainfall (Danda 2011). Some university departments of agricultural and marine sciences and a few donor agencies, have taken steps with some local NGOs to encourage farmers and fishermen to use salinity resistant seeds and saline tolerant fish varieties. For example, the Central Institute of Brackish Aquaculture is growing cultures of different fish and prawn species that can tolerate salinity and therefore able to provide profitable livelihood for the islanders. The brackish aquaculture can be a sustainable option for the islanders as the market-players, such as exporters, are showing an interest in this alternative. Similarly, farmers are also trying saline-resistant paddy varieties like 'Hamilton' with the help of the Department of Agriculture, Jadavpur University and CBOs like Nimpith Ramkrishna Mission. This kind of support acts as an adaptive measure for the farmers and the fishers affected by salinity ingress to get similar productivity as that of conventional options. However, some of the scientists are of the opinion that farmers are not fully aware about the utility of this initiative and their lack of knowledge is hindering the adaptation strategies.

We also try to make aware the farmers to bring back the traditional variety of paddy which is salinity resistant. Though sometimes they are not very willing to do so as the modern varieties grown quickly and produce more yields. The farmers have to understand that this might be the most sustainable option for them to ensure their productivity in this changing system.

A senior scientist of an agriculture department in a Government University

However, these livelihood alternatives have not come without challenges. On large and probably most significant challenge may be that these alternatives are not accessible and affordable to the poorest of the poor. In the Sundarbans, especially in the islands' pocket where most people are below the poverty line, it is not feasible to invest at least two to three lakh (0.2–0.3 million) in brackish aquaculture if it is not subsidised by the Government. Also, as stated by the community respondents, the salinity resistant seeds have been distributed by the respective Panchayet office, however the uneven distributions, often influenced by politics, make this option inaccessible to most of the islanders.

The Sundarbans, being one of the poorest regions within the State of West Bengal, officially have several employment generation schemes like: the Mahatma Gandhi National Rural Employment Guarantee Schemes (MGNREGS) and the Rajiv Gandhi Swavlamban Rozgar Yojna (RGSRY) which guaranteed limited days of employment to the rural population. However, the utilisation rate of these schemes is low in case of the Sundarbans (CSE 2012). This is evident from the statement of the Head Clerk of the Block Development Office of one of the Study Blocks, 'We have several livelihood schemes especially after floods. God only knows why there are no takers for the schemes.'

Families have adopted multiple ways of securing income and resources. The most prominent of them is the gradual shift from agriculture to non-agriculture based incomes. According to the 2011 census, the work-force participation rate has increase significantly. In the last decade the working population grew by around 28 percent. Wage labouring is the most adopted alternative, occurring with or without migration from the islands. The males are choosing different type of wage labouring options in nearby towns, repairing embankments in the islands under NREGA schemes, or working as agricultural labour in the mainland areas. However, many have migrated to surrounding cities/towns and states for non-agricultural labour work. Nevertheless, the trend is for seasonal migration rather than a permanent one. The islanders reflected that lack of secure payments and insufficient job days are the main reason for such lower utilisation of local level wage labouring schemes. The 'above', however, lack knowledge of the actual requirements of these communities, such as why they are moving from their traditional

livelihoods. The agro-fishing communities of the Sundarbans lack the skills for work like wage labouring. It is worse for women islanders, who have subsisted for centuries on river fishing, but now have only the options of wage labouring or embroidery work for which they have neither the skills nor training. There is no skill-generating programme available in the Sundarbans for the islanders to move to other options.

However, some of the 'above', especially the scientists, are of the opinion that moving out people from Sundarbans is a reflection of the lack of planning on the part of the government for transforming the livelihood of the islanders.

Life in Sundarbans for the humans would always be filled with uncertainties. There needs to be a staggered plan to move these islanders out of the Sundarbans delta. This should include the livelihood options and skill building training so that they can adapt in the new setup.

A senior agricultural scientist from a government university

Lack of proper planning by the 'above' is also evident in relocating the fishers from the sea coast in one of the Study Blocks under the tourism development scheme by the newly formed Tourism Development Board. In this particular area the fishers subsisted on caching varieties of sea fish and drying them in the sun. However, it was thought that the smell of the dried fish might put off tourists and hotel and lodge owners strongly lobbied for a relocation of these fishermen and the dried fish.

The government and the administration, irrespective of their political standpoint have been mainly interested in infrastructural developments like roads and bridges. Though this kind of infrastructural development is clearly needed in a geographically inaccessible region like the Indian Sundarbans, people's involvement is lacking in the planning of such developments. Rather, this infrastructural development became a significant dominant narrative in the Sundarbans' policy domain and often placed as a developmental parameter. Yet there is no such special people-centred developmental planning or vibrancy in the policies for generating alternatives under the climatic changes in the Sundarbans. The more recent players in the scenario whose narratives featuring Sundarbans are the market actors who became active mainly in two sectors, fishing and tourism. The tourism lobby, especially, have very strong narratives of projecting the Sundarbans as an exotic weekend tourist destination for the city people, which often ends with displacement of the marginalised, and sexual exploitation of the young women. The fishing lobby have also built a strong market system, attracting many big to mid-level fishing companies from other Indian states, as well as Bangladesh and Myanmar. However, this particular market economy has its own consequences like overfishing, polluting water, hampering the marine ecosystem with oil spillage from trawlers, and low wages for local people. These two particular lobbies have clear economic and political incentives, though their interests are not aligning with the islander's developmental needs.

The findings of this study show the 'below' understands climatic variability and its impact on their livelihoods which has emerged out of their own daily experiences. The 'middle', too, understand the variability of the climate change and its impacts. However, they lack the capacity of translating this knowledge to the 'above'. The main hindering here is their economic and technical dependency on the 'above'. Some of the 'above', scientists and donor agencies, who see livelihood uncertainty in the Sundarbans through their technical and scientific knowledge, are taking experimental measures to minimise the detrimental impacts on the Sundarbans' livelihood. However, these efforts are few and far between. Largely, policy makers lack practical knowledge of the impacts of climate change on the livelihood of the islanders. Their perceived non-severity may be the reason behind their lack of special planning for restoring the livelihoods in the Sundarbans. Furthermore, as discussed above, market forces are now adding further stresses to the livelihood security of the islanders. Special planning is needed to give local communities information, technological skills, education and employment in order to reduce social vulnerability and to cope with livelihood transition in a time of climate change.

The 'above' need a clearer understanding for future intervention for development planning and adaptation management programmes in different ecological regions. Policies need to be in place for a holistic approach to mitigate climate change and improve the livelihoods of the local communities.

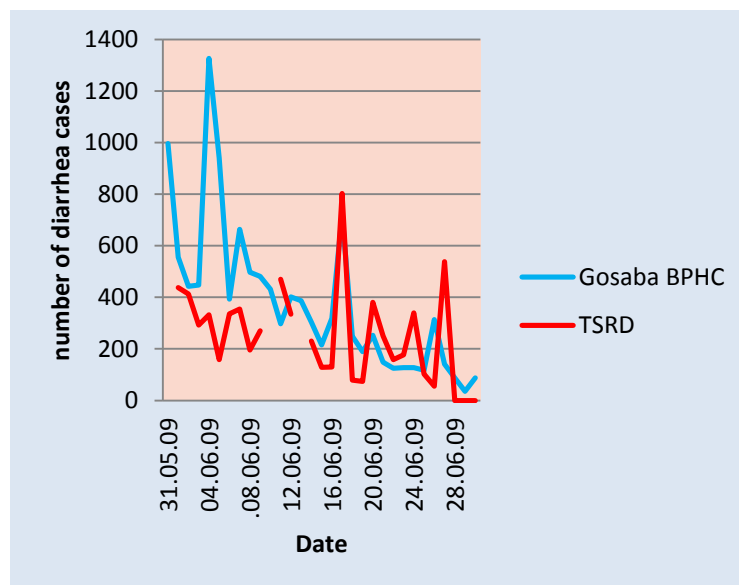
6. Climate Change and Health Systems

6.1. Introduction

The data in this Section have been supplemented by IIHMR's long term research on health of the Sundarbans people under Future Health System Research Programme Consortium.⁸ After an in-depth literature search on the health issues of the Indian Sundarbans two reports published by FHS/IIHMR, (Kanjilal *et al.* 2010a; Kanjilal *et al.* 2013) were found. Other studies are those of done by A.N. Chowdhury and colleagues (2001; 2008; 2010; 2013 and 2016) on the mental health of the islanders within the circumstances of uncertainty, fury and struggle. However, there are insufficient studies looking at the impact of climate change on health and nutrition on the people living in the Sundarbans. There are no longitudinal studies which measure the crucial impacts of climate change on the different sub-groups of the population. This shows that the health of the islanders amidst climate change is may not well recognised among researchers (Ghosh *et al.* forthcoming). One explanation may be that the impact of climate change on health has not been visible until now. However, the impacts are slowly being shown by the social determinants of health such as poverty, water and sanitation, food production systems and socio-cultural patterns of the society. We discuss this in more detail in the following paragraphs.

Climate change impacts on the health of the people of the Sundarbans in two ways, with the children being more affected by both. First is the rise in water and vector borne diseases after each episode of flooding. Second, these episodes also affect the health care infrastructure making an already weak system more inaccessible, thus depriving the affected islanders of quality-assured medical attention (Kanjilal *et al.* 2013).

Figure 6.1: Daily Number of Diarrhea Cases Attending Gosaba BPHC and Rangabelia TSRD Clinics after Cyclone Aila (May 31 - June 30, 2009)



Source: Kanjilal *et al.* 2010b

The experience of Cyclone Aila can provide a significant example of how fragile the Sundarbans health care delivery system is as it was unable to provide required timely services. Cyclone Aila created some measurable health hazards in the short term (Kanjilal *et al.* 2010b), the most significant of which were

⁸Future Health Systems (FCS) is a research consortium working to improve access, affordability and quality of health services for the poor (<http://www.futurehealthsystems.org>).

water borne diseases. These morbidities gradually become less visible but continued to weaken the community and joined the stream of regular spells of illness and under-nutrition in the long term. Kamjilal *et al.*'s study in 2010, just after Cyclone Aila, on the impact of Cyclone Aila on the health of the population found that the reported cases of diarrheal diseases in one Government health facility (Gosaba BPHC) and one NGO run facility (TSRD health clinic) were significantly higher immediately after Cyclone Aila. The number of reported cases was 1000–1300 per day at BPHC and 400–800 per day in the NGO clinic. The number of patients suffering from water born diseases was much higher in both out-patient and in-patient care services in the Government facilities in the post-Aila months compared to pre-Aila months (see Figure 6.1).

6.2. Perception from the 'Below' on Uncertainty of Health

The immediate shocks also may lead to certain long term impacts, especially on the health of the children, among which under nutrition and consequent morbidities are the most significant problems. A recent study done by Institute of Health Management Research under Future Health Systems conducted in the same Study Block explored the high malnutrition rate within the households which has to face more than one climatic shock in the last five years (Kanjilal *et al.* 2013). The result shows that about 45 percent of children among poor families who faced at least one climatic shock in the last five years are underweight. Forty four percent of them are stunted, compared to 39 percent and 33 percent respectively for the children who did not face any shock. It is also important to note that the prevalence of malnutrition was considerably less among the children who belonged to less poor households but were still subject to shocks. The study also revealed the morbidity profile of the children showed a difference between the households which had experienced climatic shock in the past five years and households which had not. I showed that 24.6 percent of the households who had faced climatic shock in last five years had children with at least one symptom relating to the Gastro Intestinal Tract (GIT) in the last 30 days prior to the study. Households who did not face any climatic shock had a much lower percentage of children with a GIT related symptom. The relative risk ratio (i.e. the ratio of exposed to non-exposed ill children) is 2.96, implying that a child who has experienced climatic shock had three times more risk of developing GIT related diseases (e.g. diarrhoea) compared to one who was not exposed to this shock (Kanjilal *et al.* 2013).

Ethnographic field work of the present study added the narratives of the islanders regarding the perceived morbidity to the above mentioned findings of the Kanjilal *et al.* (2013). According to the respondents the intensified winter has increased common morbidities such as like coughs and colds, and acute respiratory infection (ARI) by five times in last ten years, especially among the children, 'Children suffer more from respiratory infection at the onset of the winter. Something has been changed in the air now a day. We do not face such problem in our childhood', was stated by a 40 years old respondent in Study Village Two.

As the health care systems and other infrastructural facilities of the area are heavily damaged during climatic events, the people have to face severe hardships if they fall ill. Health problems arise when the same flood water is used for cooking, bathing and defecating – though some women maintained that they took the water from the top for drinking because they could not access a (functioning) hand pump. Respondents reported the spread of waterborne diseases like typhoid, cholera, conjunctivitis and skin rashes are a common phenomenon during such emergencies. They added that, as the flood water could not recede quickly due to the rising level of rivers now, waterlogging can continue for several weeks and so, therefore, can incidences of infectious diseases. The situation become more difficult for those with special physical conditions, like the aged, differentially able persons and pregnant mothers, who need continuous attention and support. For pregnant women the largest problem is where to deliver their babies. Most flood-affected villages in the Sundarbans have their own stories of women who gave birth at their temporary shelters. A 28 year old woman respondent

of Study Village One describes her experience as she was pregnant at the time of flood in 2011 and the delivery date was close:

At the night when the water level rose over the porch of our house my husband decided to leave the house as early as possible. We had to walk on that knee length water flow to reach the safe place. As my husband had to take care of my three years old boy and some other necessary belongings, I had to manage myself against the water current. I was so scared about the safety of my unborn baby, sometimes I felt breathless too.

Women respondent, Study Village One

Later her husband took her to the district hospital where she and her daughter got medical assistance. A similar experience was shared by another women respondent from Study Village Two who lost her child due lack of medical care during a periodic inundation and subsequent cyclonic event. She was very close to her delivery date when the flood struck her village in 2011. Her husband took her to a raised land under a tree, as she was feeling suffocated in the overcrowded school building which became the flood shelter immediately after the emergency. After some days she started bleeding. Her husband tried hard to get a midwife or any other woman to help as they did not have any adult female in their family. However, other females of the camp refused to help them.

Nobody came to help us. I fainted due to the bleeding. I was alone at that time as my husband was trying to manage some help for me. I don't know how I survived; maybe it was God's wish. I delivered a dead child. My husband managed some food and water for me. We immersed our first child in the flood water.

Women respondent, Study Village Two

The second major impact of climatic change are the alteration in the social determinants of health in the Sundarbans. It is creating cascading complexities by hampering the livelihoods of the islanders, which in turn affects the health and general care seeking behaviour of the people. Livelihood restoration through male migration is one of the most significant factors behind such changes. The mothers with migrant husbands are facing moderate to severe financial and human resource challenges while seeking care. Additionally, they have to take part in their household's livelihood restoration process which was not mandatory or time consuming earlier. The women islanders now have three burdens of work simultaneously: livelihoods; household chores; and child and elderly care. For them the nearest health care options are the most convenient and time saving. In their post cyclone Aila study Kanjilal et al. 2013 found an increasing dependency on rural medical practitioners, those who practicing allopathic medicine without formal medical qualifications or degrees. The rate is high in case of child health where 83 per cent of ailing children were treated by the RMPs one year after Aila, compared to 67 per cent in the pre-Aila period.

Mothers with migrant husbands have to mobilise support, mostly from fellow villagers. The supportive network also helps these mothers in securing food, shelter and cash for the treatment of a sick child. They get support in areas like household chores and cooking, day-care of children, delivery of medicine and travel to health care providers. Interestingly support mostly come from other women, both in household and community level. However, the supportive environment may have a negative impact on the healthy development of the children. This mainly impacted on the day-care of the children whose mothers are out of home for most of the time to earn money. According to the women respondents with migrated husbands, their children have to be in the care of either their grandparents, other relatives, neighbours or older siblings. The respondents are afraid that their children might miss appropriate quantity and quality of the nutritious foods, especially when under the one year of age. According to the respondents these children also lack the responsive feeding if taken care of by the elderly or very young female adolescents. Often the 'day care givers', in the absence of the mothers of the children, are at a loss to understand the real feeding needs of the child

they are tending to. Respondents also stated that to handle the situation and to make the task easier for the caregiver, they provide little cash to the children to buy ready-made junk foods available in the local tea shops, which may in turn lead towards faulty feeding practices and consequence malnutrition

I have to be out whole day to crab collection so that I can supplement whatever little my husband sends from Chennai. My elder daughter of fourteen years looks after my younger son of close to two years. I usually cook for them before I go. Sometimes I also give her some small cash for snacking as I feel bad that they have eaten cold food.

A mother of two from Study Village One

6.3 Coping strategies

As discussed earlier, a typical mother of Sundarbans, with no male member to support her, would seek health care for herself and her children from the nearest source which often is a village doctor or Rural Medical Practitioner (RMP). The overwhelming dependence on RMPs is evident in the study done by Kanjilal *et al.* (2013), and is also evident five years after cyclone Aila. These providers already dominated the health care market in the Sundarbans and repeated climatic shocks strengthen their dominance as they are only available source of health care delivery during emergency periods. The rate of utilisation of RMP services was significantly higher for sick children of poorer households (Kanjilal *et al.* 2013). Given that the RMPs practice without any recognised or universally accepted formal training process, the quality of their care can be questionable and have serious consequences on the health of the islanders (Kanjilal *et al.* 2013).

Coping strategies in the context of health seeking behaviour, as discussed above, is critically linked to significant uncertainty in the public health delivery system of the Sundarbans (Kanjilal *et al.* 2013). For example, there are only three Primary Health Centres (PHC) in one of the studied Blocks, Patharpratima, when following the standard population criterion (one PHC per 30,000 population), there should be at least eleven (Kanjilal *et al.* 2013). The shortage of frontline workers (Auxiliary Nurse Midwives (ANM), Anganwadi Workers (AWW), Accredited Social Health Activists (ASHA), is also evident. Kanjilal *et al.* found about one quarter to one third of the required manpower was not available (Kanjilal *et al.* 2013). Ethnographic findings also reveal the state of unpreparedness of the existing health care system to deal with the immediate health needs after a climatic shock. During ethnographic conversations with the RMPs within the study area, only one could acknowledge the need for stocking adequate anti-diarrheal and emergency medicines during monsoon season. The frontline public health workers are also very much dependent on their higher authority to take any steps. Same is true for doctors in charge of Primary Health Centres (PHC) and BPHC.

6.4. Perception of the 'Middle' on Health Uncertainty

The section of the 'Middle' which is playing a crucial role in the health of the islanders is that of the local NGOs and CBOs. They are the active partners in delivering health services to the people. Given the low effectiveness and coverage of the public health care system, an alternative and innovative delivery model was designed for the Sundarbans in late 1990s by the Department of Health and Family welfare (DoHFW) of the Government of West Bengal under the State Health System Development Project. The model involved a partnership between Department of Health and Family Welfare and a few local civil society organisations to provide mobile health clinic services to remote islands by using motor launches. Starting with one voluntary agency (Tagore Society for Rural Development (TSRD)) working in 24 villages in two blocks of South 24 Parganas in 1999 the experiment gradually expanded to involve more agencies and to provide services to 351 villages (38 per cent of the Sundarbans' population) until the end of project period (2004). In more recent studies done by Kanjilal *et al.* in 2013, a total 37 NGOs are active in one of the study blocks, out of which only four are providing extensive health services and 16 have partial service provision on health. The main services this

significant 'Middle' is providing are mobile health clinics and community delivery centers to the remote parts of the region. Other programmes also include awareness generation, sanitation and hygiene promotion, and nutritional rehabilitation. They are funded by the government through a PPP model or by the international donor agencies. However, Kanjilal et al. (2013) noted that these service provisions are unable to meet the needs and demands of the people, and Government funding to these services are declining.

By far that was the best scheme in reaching the islanders of far flung islands bordering Bay of Bengal. The people looked at our doctors as some form of Messiah. People still reminisce about that programme.

Secretary of a prominent organisation which ran a fully equipped boat with doctors and basic medical facilities

However, apart from the fact that the numbers of such services are small compared to people's need, the initiative is also constrained now.

The main problem in maintaining my Community Delivery Centre (CDC) is to get MBBS doctors to come and stay in these remote parts where there is no electricity, fear of climatic shock and inaccessible transport. With the amount that the government provides us we struggle to get doctors who are ready to take risk and even if they do it, are not long before they leave. The maximum period that a doctor has stayed with us is six months. Also they make demands like staying here for four days a week. We are supposed to maintain a 24/7 facility and what would happen if we receive a complicated case when he is absent. Maintaining this facility has been a headache and it has considerably eroded our credibility with the community. Government should increase or make it mandatory for the doctors to serve Sundarbans at least one year in their initial carrier.

A health supervisor of an NGO running a CDC

A part of the 'Middle', organisations working on health issues, cite that climate change, which arguably attracts most funds and which has become a veritable buzzword among the decision makers, has overshadowed the health aspect.

There had been a spurt of funds both from the state and the donor agencies in the immediate aftermath of cyclone Aila in 2009. In the last two years the funds have dwindled and now the donor shift is towards education despite the fact that the literacy rate of the islanders are pretty high at over 70 per cent. The state has also closed down the Mobile Health Launch scheme. The state is asking us to act as their pre-publicity agents for their various schemes. But what would happen to the islanders in the remote islands where the government services do not reach?

Secretary of an NGO which has shifted its focus recently to awareness generation from service delivery

Over the years prominent civil societies, owing to funds pouring in for disaster response and relief and during the tenure of prominent institutional funders of the governments, have recruited heavily, mostly from the areas and communities in their influence. With the changed priorities of the government, and due to increasing funds being directed towards saving the flora and fauna of this UNESCO Heritage Site, they have faced a severe problem in maintaining human resource infrastructures. With the prospect of losing influence in the community due to retrenchment of staff most have taken the easy way out of being implementers of the government schemes. Most interactions with the civil society leaders have suggested that this has been one of the crucial reasons for their inability in advocating against the ineffective design of the schemes of the state actors

6.5 Views from the 'Above' on Health Uncertainty

As far as Sundarbans' health is concerned the 'Above' have a contrary view-point from the 'Middle'. While the NGOs providing health care services are vocal about limited financial and technical support on the part of the policy makers, the National Health Mission (NHM) wing of the state health directorate argues that, 'NGOs of Sundarbans are not submitting implementation proposals on time or sometimes not submitting proposals at all', an official of a State NHM cell. He cited the example of the 2012–13 planning process for NHM, saying, 'There was not a single NGO application under the Innovative scheme at block level'. Other interviewed officials, both at district and state level stated, that NGOs have also not shown any interest in taking part in schemes for referral transportation under the PPP model in several blocks in the South 24 Parganas District. The officials were also of the opinion that the organisations have very small area of influence and therefore would not be able to add value in planning meetings where discussions of schemes on a macro level take place. There is also considerable disagreement between them on health issues with each trying to push health interventions that match their respective strengths.

Designing a scheme requires technical and medical knowledge which we do not expect from the NGOs of Sundarbans. Hence there is little use in inviting them for health policy meetings. We are trying to identify district specific remote areas in which we plan to invite them to provide basic services to the population.

Officer from State NHM Cell

However, in the absence of convergence and mutually shared understanding of the climate change linkage with the health of the Sundarbans, the 'Above' has been able to provide very little strategic guidance to the 'Middle', particularly on contingency planning and adaptation measures. The absence of convergence and institutionalised sharing among diverse domains of service provision and line departments of the state agencies has given rise to fragmented perceptions of the health, agriculture, fisheries, irrigation, land and land revenue and flagship initiatives such as the Sundarbans Affairs Department.

Unlike state level health officials, the local front line care providers exhibit more contextual ground knowledge on health-climate linkage. Although, none of the respondents could make a clear link with the climate change impacts which the Sundarbans has been facing in last three or four decades, during the interviews most of the block and village level providers (both Government and informal providers) frequently mentioned the significance of climatic events when describing health conditions. Instead of understanding that it is linked to bigger manifestation of the climatic changes, like sea level rise or livelihood transformations due to salinity intrusion, the understanding is limited to seasonal variability. Providers put stress on the lack of general awareness of the patients as a reason for health conditions.

Interviews with the private and public health functionaries reflected a huge gap in training and skills in handling emergency situations or disaster responses. Health functionaries at different levels unanimously agreed that training on disaster management is limited to giving first aid and evacuating people. There is no element of handling disease outbreak or contingency planning in the training. Providers stated that they store some emergency medicines and other materials as a contingency planning as *per* their understanding, especially in the disaster prone areas.

Motivation, one of the most significant components of any health workforce, seems to be falling as transportation to the island areas is not favourable. Situations are aggravated during the monsoon and climatic emergencies, and this scares the providers residing outside the island and who have to travel daily in order to provide services. Higher level medical authorities admitted that sometimes the ground level staff lack the motivation due to the hazardous travel. They sometimes arrange motivational training for the workers, however, the effect is not long lasting.

The findings have come up with some crucial and clear pointers. Health is probably the most neglected issue across all three layers of this study. Failure to link Sundarbans' health with the changing climate is probably the most significant cause of concern. The 'Below' who are busy with every day struggles and restoring depleting livelihoods, do not perceive health as their priority. This, in combination with inaccessibility and unavailability of the health services, leads them towards mal-adaptation in the form of seeking health care from unqualified providers.

The 'Middle' also fail to understand the importance of health uncertainty due to climatic changes in the Sundarbans. Irrespective of being a prominent partner in health care delivery system for decades, the most prominent part of the 'Middle', the NGOs and CBOs, lacks the technical knowledge to link health with climate change. Moreover, most of the civil societies were unaware about the different committees and sub-committees within the State Policy and Sector Reforms Cell (SPSRC), the planning body for informing the nature of interventions in the disadvantaged areas under the National Health Mission. Importantly, the non-existence of any civil society forum of note has diminished their role in representing the community in its demand for health care. The civil society organisations are well connected with the community. However their efforts to influence policy, especially the health policy, for Sundarbans is miniscule due to the fact that they do not want to evoke anger of the State authority

Scientists, though expressing concern about health impact of climate change, have implemented no such longitudinal scientific research in the Sundarbans which would to capture the extent and intensity of the health uncertainties of the islanders. It reflects their perception is not being translated into action. At the same time policy makers continue in their lack of knowledge with regard to health too. The authority which is exclusively responsible for the Sundarbans' development is not considering incorporating health into their present or future planning for the Sundarbans. The health officials do not have proper knowledge regarding the health demand and need of the islanders. They are dependent on the local administration as well as on the NGOs/CBOs. Nevertheless, lack of convergence between the significant 'Middle' and 'Above' level actors makes it difficult to produce a roadmap to deal with health uncertainties caused by the climatic change.

7. The Controversies Around Embankments

7.1 Introduction

Embankments have always been the lifeline of the Sundarbans. According to Dr Kalayan Rudra, the colonial rulers built the embankments to stop the ingress of saline water which affected the siltation process of the rivers. Later, due to the changing geomorphological process, river beds had been elevated but the flood plains remain at the same height. This in turn made the inland vulnerable to water-logging due to high tides and intense rain water (Rudra 2010). Currently most of the area in the Sundarbans is less than three metres above sea level, which means it is extremely vulnerable to tidal inundation and cyclonic storm surges (Rudra 2010).

After the devastating cyclone Aila in 2009, which broke at least 400km of embankments, a task force on 'Restoration of Sundarbans Embankments damaged by the cyclone Aila' was formed by the Union Ministry of Water Resources. Concrete embankments were proposed by the Department of Irrigation which was recommended by the task force and approved by the Ministry of Water Resources as well as the Planning Commission. The total budget for the project sanctioned is Rs5000 crore (50 million) out of which Water Resource and Planning Commission is bearing three quarters and the remainder is to be paid by the State Government. The project has also engaged private partners, like Consulting Engineering Services, to oversee the implementation of this three year project. The State Government has started working on land acquisition and reimbursing respective land owners.

According to Irrigation Department officials, and their website, this new embankment is going to be higher than it was previously, which will need more land from the islands thus making the boundaries smaller. It is planned to slant towards the coast covered by the mangrove as first line of defense against storms or cyclones. In line with scientific expertise from irrigation departments, incorporation of geo-tubes has been proposed in the more erosion-prone zones. However, rest of the embankments is going to be earthen.

After cyclone Aila, almost 800km of the region was severely damaged. The project seeks to reconstruct embankments in this stretch. To protect it from erosion, experts suggested covering the riverside slope of the embankments with polypropylene sheets and concrete brick blocks. However, the cost would come up around 15lakh (1.5 million INR) *per* kilometre for this kind of establishment (Government of West Bengal n.d.). While the construction of the concrete embankments can create job opportunities for the poor islanders in terms of about 15 million semi-skilled and skilled person days, the construction work has also increased the opportunities for contractors who are using heavy machines (rather than human labour) for most of the earthen work.

7.2 Perception of the 'Below' on the Embankments

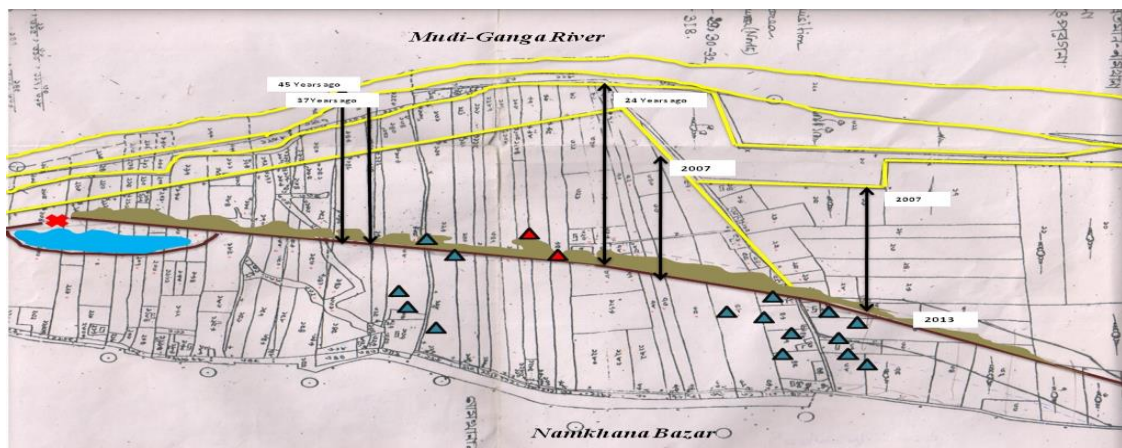
In both the study villages, concrete embankments were propose by the previous Left government in the aftermath of cyclone Aila. This ran into problems with the villagers who owned the adjoining fields. They refused to hand over their lands due to the poor track record of the successive governments in providing compensation at market price, or for that matter any compensation at all. In Study Village One, respondents stated that they have got the Aila compensation, while others reported not to have received any compensation yet. Most of the respondents stated that they got half payment, whilst expressing concerns about political bias in part of the disbursing authority in the allocation of the money.

I have received only a quarter of the money from the Panchayat but my cousin got the full amount as he has political connection with the ruling party.
A senior male respondent in Study Village Two

I had to rebuild my house inside the village where the cost of the land is much higher. I had borrowed two lakhs from the local money lender, thought to pay the money back when I would get the compensation money from the Panchayat. But I haven't got the money till now. I had to sold another plot of land to repay the loan.
A male respondent from Study Village One

There is large scale mistrust among the villagers against the state machinery in terms of the rehabilitation and prevention measures. According to the respondents the local government machinery would be a silent spectator in times of extreme high tides, rainy months and disasters like flood and cyclone which has only added to the uncertainty of the vulnerable local populace. The term 'ostityahin' or 'non-existent' to describe the government and its relief measures, particularly those living in the vicinity of the river or the sea, has time and again come up in conversations with the islanders.

Figure 7.1: Land Erosion Over the Past Forty Five Years



Source: IIHMR

While doing ethnographic field work, we came to know about the history of land erosion in the village. From the past many years huge land areas have been engulfed by the river making the people landless. The main reason, as perceived by the villagers, is that the force of water is very high near this end, hence causing damage to the embankment. For the past 45 years, the embankment has been wrecked five times causing half of the village under water (See Figure 7.1). The current status of the embankment is also appalling. There is a portion which was breached during cyclone Aila causing continuous intrusion of saline water into the agricultural fields. To prevent this a temporary construction has been made by the irrigation department. The households marked in red colour were lost due to sudden land erosion leading death of two people, but still many households are living on the embankment.

The respondents were also concerned about the timing and process of work that the local contractor is carrying out under the aegis of large multinational companies. One respondent from Study Village Two stated:

As far as the repairing of embankments goes, the irrigation department has tried to construct the temporary embankment every year but it gets broken during high tide. The time of construction is never right. If they construct it during April-May it will resist, but they invariably choose July-August (Monsoon) to do the job. To protect the land erosion they prefer

constructing bamboo structures and using iron rods on the banks. We villagers submitted a joint petition to the Block Development Officer (BDO) for construction of tube wells and embankment by placing boulders on regions where the maximum damage occur because of high force of river water (Hataniya-doaniya river). It will ultimately turn the river current and prevent damage. The support from the Panchayat administrator and Panchayat pradhan is negligible.

Respondent from Study Village Two

Findings revealed a significant gender dimension regarding the construction of the embankments. The women respondents of Study Village Two during focus group discussions reported that the men folk of the village appointed by the contractor are not taking proper care to build the embankment. Most of the time they did the work quickly in irresponsible manner ultimately leading to repeated breaching of the embankments. The women respondents also stated that the men, despite of being their brother, husband or other relative, were mainly working for the handsome wage of Rs250 a day, as for that they would not have to migrate out of the Sundarbans. One women respondent from Study Village Two stated, 'they made the embankment in such a manner that even during a single high tide it would get washed away. Then they would get another chance to rebuild it and get wage in return'.

The women respondents are of opinion that responsibility of construction of the embankment should be with the women as it was just after cyclone Aila happened. They argued that the embankment they had built then was intact for four years until the inundation of July 2014. One of the respondents stated, 'We are the mothers. Protection of the children is our first priority. So we can do a better job to build the embankment. Nobody can match our concern'.

7.3 Coping Strategies

In the Sundarbans coping strategies regarding shelter and embankments were found to be event-specific based on local knowledge and innovation, because most of the respondents were not aware about the actual impacts of climate change and its variability. For example, they are now spending huge amounts of money, even to the extent of borrowing from others, to build concrete roofs to protect their houses from frequent cyclonic events. This expenditure makes them more vulnerable to chronic indebtedness and loss of assets. As a long term coping strategy many people who have good socio-economic conditions have started constructing houses with cement pillars. The respondents reported that they want to construct cement houses but the cost of pillars is high. For example the cost of eight pillars is approximately Rs56,000 which they cannot afford. They have received only Rs10,000 from the cyclone Aila relief fund, not enough to cover the costs of constructing this type of house.

In answer of the question on coping with problems of uncertain shelter, respondents stated their faith and belief in God. According to them, only God can save them from the fury of nature and rest they would take care of. As contingency planning for facing another cyclone Aila, respondents stated, 'We will run towards the school along with the family to save their life. We will only take some cloths and dry foods if time permits them to do so' (a respondent in Study Village One).

Respondents stated that in future, if their socio-economic condition improves as they are educating their children, they will try to move inside the village as they do not feeling safe living besides the embankment. However, but they have not intention of leaving the Sundarbans. Their feelings can be sensed from the following, 'We cannot leave the mother land as it is become furious to us. Most probably we did something wrong. God will surely protect us' (Villager, Study Village One), and, we were born here hence will die here too' (Villager, Study Village Two).

Figure 7.2: Temporary Embankments



Source: IIHMR

Figure 7.3: Temporary Tents on the Embankments (for families who lost their houses after Cyclone Aila)



Source: IIHMR

7.4 Perception of the 'Middle' on Shelter Uncertainty

The 'Middle' is aware and concerned by the issue of embankments which they say is mostly manifested as a by-product of political bias and administrative red tape. A substantial portion believes that the state of the embankments is worse than pre-Aila period. They rue the lack of a comprehensive disaster preparedness and response mechanism. 'In the likelihood of a repeat occurrence of any climatic shock of a similar magnitude may spell disaster to thousands of the islanders who live by the embankments', stated a retired school teacher working voluntary for the betterment of the people living on the embankments. He also cited the example of the successful disaster response in case of Cyclone Sidr in neighbouring Bangladesh Sundarbans. He also noted that, 'there should be a demand for a planned budget and a trained task force among the community youths'.

A section of the 'Middle' is also taking an active role of facilitation between the administration and the general population. This educated section of the Sundarbans is trying to help the islanders collect their land papers and claim compensation from the Government.

The Block Development Officer said we can only send the report, but money should come from the Government. It is actually public land. Government should give the money in advance. People are still living in other's courtyard. We are giving continuous petition at the BDO office but nothing is happening.

A Self Help Group (SHG) leader from a village who is organising villagers to file a case against the Government around these land issues in the village

Most of the 'Middle' gave their opinion that the situation and debate surrounding the concrete embankments necessitates the convergence of knowledge and experience of the islanders with the experts in order to plan a infrastructural model factoring in the uncertainties of climate change and its effect on the ecology for the Sundarbans. The 'Middle' mostly remains optimistic about the locally based solution and is ready to shoulder responsibility of pushing forward the ideas to the decision makers and the voices of the 'Below'.

The least we need to do at this point is to protect the breaching of embankments and sharing knowledge and best practices to conserve ecology for long term sustainability. The land issue can be arrested with sustainable relocation and compensation measures through

convergence initiatives between the government, the political representatives and the civil society.

A CBO head from Study Village One

7.5 Perception of the 'Above' on the Embankments

Evidence-based planning and decision making by the policy makers, modellers and planners by tapping the scientific knowledge on climate change and adaptation measures is almost absent. This is compounded by the fact that due to this largely top-down planning the local level government resources of traditional adaptation measures and the community's resources are seldom realised. We know that concrete embankments are the solution. Due to red tapeism and land acquisition problems it is taking us time', Block Development Officer of one of the studied Blocks.

Even within the government the line departments responsible for the embankment issues like Environment Department, Irrigation Department, Disaster Risk Reduction Department and Land Acquisition Department see the Environment Department as largely a standalone department with its own set of fixed agenda. For example, the Irrigation Department would not tap the resources of the Environment Department in the planning its supply side strategies.

We had once tried to link both Environment and Disaster Risk Reduction Dept. together through our constant facilitation. Because as a donor agency working with DRR approach in Sundarbans we know how much it is important to work together for the sake of the people. But all our efforts went in vein.

The Project co-ordinator of Sundarbans Project of an international donor agency.

The scientific community has taken an alarming standpoint where the concrete embankment is concerned. According to an eminent Professor of the Indian Institute of Management in Kolkata, the Sundarbans' ecosystem may become affected by the heavy duty engineering work if done without prior planning to keep the ecological aspect in mind. Similar concern is echoed by the State head of the Sundarbans climate adaptation programme of an International Donor Agency who has said, 'the biodiversity of the region specially the flora will be greatly affected if the region get concretised'. According to an eminent river scientist, instead of any complex technology one should look into a cheaper local level solution like bamboo mats which will allow the river to deposit silts. He is also in favour of utilising a local labour force to ensure an employment generation. The scientific community has also opined that a long term study is require in understanding the nature of the river before undertaking such large engineering works. Similar concerns have also come from one of the chief officials of the State Environment Ministry who stated, 'People of Sundarbans are resilient enough to handle the odds of the climate since their habitation in this delta. Locally based solution is the best for them'.

Some scientists have stated that significant transformational opportunities exist to protect the rapid land erosion in the region. Traditional construction using boulders might not be appropriate for the islands as the Hooghly River estuaries are ecologically sensitive (Chaudhury and Choudhury 1994; Ghosh *et al.* 2003). Methods like replacing the land loss with sand is also not feasible due to costs and tidal turbulence along the estuaries. Hence the oceanographic scientists working for decades on Climate change in the Sundarbans suggest (Ghosh *et al.* 2003) the use of bio-engineering techniques with plantations of a few species along the coast line can be a good option for holding the soil in place and preventing further erosion.

The issue of embankments reigns supreme. For an archipelago which has more than 3000km of embankments, of which only a small portion is permanent, this is only natural. Always a volatile one, the issue of embankments has become a live volcano since cyclone Aila which breached the fragile embankments at many points. Even the most optimistic of the islanders would say that every high tide

has taken on the nature of a flood, inundating schoolrooms, homes and all other possible structures almost every day with clockwork precision. The debate lies over the pace and the manner in which the embankment issue is being tackled. The 'Middle' is not unanimous in its position. A section of the media has targeted the pace of the engineering work, laying the blame squarely on governance. However, a tiny but significant section of academicians has urged that the manner in which the issue of eroding embankments is being addressed should be judged by the yardstick of sustainability. A vocal 'Middle' section actually living on the islands – as well as most of the 'Below' which has been historically relegated to silence – is against this knee jerk reaction to the question of frangible embankments and the manner in which the issue is being tackled by the 'Above', i.e. the policymakers and the government. The section of civil society is vocal with regard to how climatic uncertainties are dealt with by the higher authorities. For close to 300 years the islanders have relied on the traditional knowledge of building bunds by forming informal cooperatives of the villagers, the villagers' *samitis* (local informal groupings), even before the advent of the government-endorsed Panchayati Raj. There have been lonely and discrete voices from river scientists, hydraulic experts and from among the engineering community, who backed this traditional knowledge of community bund-building and mangrove plantation on the basis of the indisputable fact that in the Sundarbans, being an active delta, the accretion and erosion would continue and the saline water would eventually corrode the base. Thus there is lack of knowledge among the 'Above' to tackle the problem and a consequent reluctance on the part of the establishment to go full throttle on the issue because the plan of concretising the embankment inevitably brings up the fundamental issue of land that directly affects the basic human rights to livelihood and shelter. As embankments corrode and crumble, land must be acquired to replace or reinforce them with concrete ones. With the pressure on cultivable land spiralling steeply, there is a deep divide among the 'Above' on the contentious issue of land acquisition as it touches the mass.

The 'Below' is highly anxious about their shelter as they are experiencing respective uncertainties almost daily. It creates a collective consciousness among them which they are now translating into agitation and protest. A gender divide among the below itself has also been noticed as women are more concerned for the safety of their children. The middle is very much aware of the uncertainties related to shelter and on this issue they turned their perceived uncertainty into actions, such as facilitating the 'Below's' voices to the 'Above'. The 'Above' is also aware of the issue of shelter. However their divided perceptions are backed by political interest and technical knowledge, creating a strong inertia to take a sustainable solution for the shelter uncertainties at stake.

8. Institutional Arrangements and the Lack of Coordination

8.1 The Project-Policy Dissonance

Key policy actors at both the state and district level lack clarity and awareness about the local impacts of global climate change in coastal regions and also of understanding of the nuances of the highly dynamic coping systems of the islanders. The local institutions, both formal and informal, have been largely unable to communicate their needs, demands and challenges to the formalised state institutions that determine policy for this archipelago. The lack of direction in the establishment and sustenance of institutional linkages has led to a proliferation of numerous official schemes by the formal institutions without accounting for the plurality of community's response in dealing with climate uncertainty. An example of this complex institutional arrangement is the Public Health Engineering Department which needs to bore new tube wells. However, the management of ground water belongs to the Panchayat and Rural Development Department, emergency services fall in the remit of the Disaster Risk Reduction Department, whereas food distribution to children and parents is the responsibility of the Department of Women and Child Development Affairs. The coordination between public and private stakeholders comes from the general administration, whereas official communication comes from the Information and Communication Department.

Box: 8.1: Structure of Sundarbans Development Board (SDB) and Sundarbans Affair Department (SAD) (from the website of the SAD)

A specialised agency, the Sundarbans Development Board (SDB) was created in 1973 for socio-economic development of the area. The SDB was initially under the Planning Department of the Government of West Bengal. The Board was entrusted with:

- Formulation of an integrated programme for effective utilisation of resources placed at its disposal from various sources;
- Co-ordination of execution of plans for the development of the region;
- Supervision of the execution of any project for the development of the region as a whole or part;
- Review and evaluation of the progress of implementation and adjustment in policies and measures as the review may indicate.

At the initial stage the main function of SDB was planning and coordinating the development activities of the region. The Board also became involved in actual implementation of development projects, which primarily consisted of infrastructure improvement, re-excavation of derelict channels and tanks (under the 'food for work' programme), promotion of agricultural works, development of brackish water aquaculture, mangrove plantation, setting up small village industrial units and animal husbandry. To take forward developmental efforts in the region the Sundarbans Affairs Department (SAD) was created in January 1994 and SDB was placed under SAD with a state minister-in-charge. The Department promotes social, economic and cultural advancement of people residing in the Sundarbans. It coordinates development schemes and projects in the area, provides infrastructure facilities through improvement of rural communication, water resources, and preservation of ecological balance, provides facilities for the development of the agriculture including minor irrigation and drainage system and allied matters. The SDB is now, constitutionally, a district development agency guided by the decisions of a Board comprising elected representatives (Member of Legislative Assembly (MLAs)/Sabhapatis), Administrators (District Magistrates of the two districts), noted social workers and non-government organisations (NGOS), and representatives of State Government Departments. In terms of Rules of Business framed under Article 166(3) of the Constitution of India, the Department of Sundarbans Affairs is to perform the following functions of the Government: Livelihoods generation such as agriculture, pisciculture, forestry; water supply and sanitation; and disaster risk management.

The Green Bench of the Kolkata High Court has passed several rulings with respect to conservation of wetlands with regard to the Ramsar Convention (the Sundarbans is the largest single block of tidal halophytic mangrove forest in the world) for strict adherence to the norms by the decision makers and representatives from local NGOs, communities, businesses and the fishing industry. Surprisingly the Green bench is silent when it comes to decrees regarding policy documents on developing translating and adapting mechanisms to facilitate their use by the local community. Several violations by the fishing and the tourism lobby with regard to destruction of the embankments and livelihoods of the marginal fishermen and women have never been dealt with strongly by an effective environmental regulation.

The interests of the trade lobby, fishing and tourism, seem to override the necessity of a clear and coherent strategy to combat climate change and its effect on the local population. That the institutions which make macro-policy are unable to decide from conflicting evidence on climate change from the academia is evident from the fact that there have been claims and counter claims from two distinct school of thoughts. A former official of the SAD has said, 'The island with human habitation gets eroded more than the islands with no or less human habitation as there is a large mangrove cover to resist erosion'. The idea is to forecast and make people-friendly sustainable plans according to the changing river course patterns. One of the officials from the Forestry Department stated, 'Yes, we should be talking to the scientists and the local governments more to make future plans. The situation indeed needs well thought of pro-people policy intervention but it is definitely not a cause to panic'.

The line departments like health, women and social welfare, employment generation schemes, and irrigation are unclear of their remits with respect to SAD due to the ambiguity of its role. SAD was formed essentially to oversee governance and support to the people living in this climatically fraught and geographically unique terrain. One of its mandates is to be consulted by an advisory body with members drawn from civil society, environment activists, people's representatives and academia. Over the years SAD has been reduced to an ineffectual body largely because its decisions are not binding on the other government departments, not even on the SDB which has its own centralised construction-driven agenda with no willingness for consultation with representatives of the people.

Health, Irrigation and Child Development Departments do not consult the Board. They implement stand-alone schemes largely on an *ad hoc* basis. Most of these programmes are designed without consulting the local institutions and as a result they largely do not reach those most in need.

Secretary of a local NGO and an ex member of the SAD Advisory Board

At policy level few transformational changes can be noticed in past 10–15 years. Most significant is the political regime change in the power structure in the State of West Bengal. The new Government has formed some new boards including the Gangasagar-Bakhhali Development Authority and the Fisheries/Tourism Joint Authority whose main focus is on promoting eco-tourism and fishing-tourism in the Sundarbans. According to a new Government order the Sundarbans is now going to be a whole new district comprising the 6 Northern Block from the district North 24 Pargana and 13 Southern Block from the district South 24 Pargana. However, some of the 'Above' and 'Middle' like sociologists working in Sundarbans, media and NGO personnel opine that there are few structural changes in the bureaucracy as far as the Sundarbans is concerned. The bureaucratic policies implement the same general plans and programme under the different departments without counting the special needs of the Sundarbans and voices from the 'Below' and the 'Middle'. Political vibrancy of the State of West Bengal could not ensure vibrancy in policy making for the Sundarbans delta. Sociologists working in the Sundarbans expressed their concern that formation of new boards or separating Sundarbans as a district will only create overlaps among the already existing one.

The institutions that are regarded as a credible source of news and views by the people of Sundarbans, local newspapers, are unsure of the motives of the policy makers and donor agencies and the efficacy of the programmes for the islanders to adapt to the climate change and the resulting uncertainties, so therefore they largely do not lend their weight behind the initiatives. Academia and the media have been uncertain of each other largely because of each one's inability to realise the potential of the other. An editor of a local newspaper has stated, 'We know that the scientists have a crucial role to play to get the government to act on the basis of their findings but we never seem to talk to each other. As a result we are unable to communicate their evidence based findings to the policy managers'.

The lack of convergence has resulted in a lack of structural and sustained dialogue with the local level institutions like Panchayat and self help. The growing dichotomy between perceptions of policy makers and grassroots institutions have prevented a re-evaluation of the threat and risk perceptions due to the ever changing nature of climate change uncertainties that is manifested in new challenges in the domain of livelihood, health and embankment issues. 'We only know that there is a government when they hold meetings before votes. We have seen two different regimes in the last three years. Both seem equally indifferent', stated by a father of two children who continues to live a stone's throw away from a temporary embankment in Study Village Two. He continued, 'the babus (officers) of Irrigation Department would only work if they are pressurised by the Panchayat (local governments)'.

Cases abound in which hundreds of islanders continue to live in makeshift shelters along the embankments. According to respondents, the Government has neither concretised the embankment nor given them alternate spaces to build their homes. However, the block level irrigation officer stated that they are, 'unsure which part of the 3000 km long embankment needs priority attention'.

There seems to be a lack of connection with scientific knowledge from environmental experts to draw up a blue print. This uncertainty has been exacerbated by lack of motivation gain knowledge and insights of the sufferers and to build convergence among various departments and academia to act on scientific evidences. The policy implementers at local level are also uncertain about what is the 'right' evidence to act upon. As a sub-divisional officer of the one of the Study Areas, stated, 'Sundarbans being an active delta we also factor in change in river courses and land submergence. There is confusion on the erosion and attrition rates and also on the quanta of sea level rise'.

The relevant government departments like the Irrigation, Disaster Management and Environment Ministries have also stated that there are not enough scientific enquiries to gauge the localised rise in sea level and its related consequences. The lack of motivation in paying heed to the people's voices has resulted in *ad hoc* measures such as bringing in agencies (who did not have any knowledge of the islands, their erosion patterns, and the nature of their soil) to build embankments. All these measures were taken without the consent of the people who live along the embankments.

The lack of compensation, either in land or money, is also a concern.

It is five years since they took my husband's land. We are yet to get any money or alternative land. And I see no sign of any embankments coming up. We have filed a case in the court. From being a farmer he, now, have become a daily wage earner.

A female respondent during the course of ethnographic field work

The slow nature of the government departments' dealings have spread and the people nearby have refused to part with their land for the building of embankments. The line departments did not get the local *panchayat* into their confidence and they are now unable to convince others. The concerned department blames the finance department for not releasing the funds. To them uncertainty of the rising river bed and the accompanying erosion pales in comparison to what they describe to an abject apathy of the 'forces' whose inaction frustrates them. The islanders know of the myriad schemes and

their benefits. And they also know that the decision makers have bungled in their oversight of implementation.

Decision makers have knowledge of the concrete uncertainties at stake. They seem to be well versed with published literature speaking of climate change being linked to exacerbation of existing problems in terms of water quality and uncertainties in accessing water supplies.

Their uncertainty of viewing the manifestations of long-term change, which focuses on climate change, neglects other key drivers which include, socio-economic changes caused by unsustainable and unscientific policy including land purchases by large tourism lobbies, technological changes due to mainland corporate fishing, political transformations, conflict and demographic changes due to large scale migration and changes in women's workforce profile, food insecurity, and health issues. These drivers of change have direct and indirect impacts on local people's marginalisation and their lack of recourse to social justice.

One probable explanation of the institutional uncertainties may originate from the lack of connection, not only between the 'Above' and the 'Middle' but also between the 'Above' and between the 'Middle'. The findings suggest that there seems to be a lack of connection with scientific knowledge from environmental experts to draw up a blue print in part of the policy makers. The divergence has been exacerbated by lack of motivation and attitude to get connected with other each other and build convergence among various departments and academia to act on scientific evidences. The donor agencies, a significant part of the 'Above' are not particularly interested in getting connected with the policy makers due to overpowering political influence. However, they are well connected with the middle level NGOs/CBOs for implementing their development programmes in the Sundarbans. Nevertheless, this parallel implementation by donor agencies ('Above') and NGOs ('Middle') is a patchwork which is benefitting only a miniscule portion of the people of the Sundarbans. Yet these politics and dynamics worsen the situation further. For example, one local level NGO that is working in a particular region in Sundarbans is the partner for different donor agencies and they are only focussing on that particular region. Other regions with similar challenges are completely ignored and do not benefit from donor funding.

9 Discussion and Conclusion

9.1 Discussion

The preceding sections have focussed on the standpoints of different actors concerning climate change in the context of the Sundarbans. The 'Below' have clear perceptions about climate changes affecting their lives and report increased heat, overall colder winters, reduced rainfall and frequent floods and cyclones. The 'below' also perceive the negative effects of climate change in terms of their ability to make and sustain their livelihoods. Most local perceptions concerning climate change were consistent with the scientific evidence regarding the vulnerability of Sundarbans to climate change.

These changes are taking place in a very charged and political environment. The Sundarbans are part of the North 24 Parganas and South 24 Parganas districts of West Bengal, districts which have reportedly witnessed a large number of deaths due to political clashes. This political tussle on the issue of compensation of land and areas to be earmarked for embankments is being carried out by the islanders themselves following the wishes of their state political heads in Kolkata. Most islanders perceive that their uncertainty is partly human-made. Nature makes their life uncertain but, paradoxically, also adds an element of certainty to their livelihoods, most certainly for fishermen. But increasing imposition of restrictions by the 'Above' on fishing, prawn-catching, etc. on the plea of preserving nature has only served to intensify the climate-induced uncertainty afflicting the lives of the 'Below', while robbing them of the compensation hitherto provided to them by nature. Thus, the dominant feeling among the 'Below' is that a political debate orchestrated by the politics of the 'Above', in collusion with powerful business interests, has restrained the vulnerable island citizens from voicing their perceptions on the human-induced climate change, while at the same time weakening the natural bulwark relied upon by the 'Below' against climate shocks.

The idea of climate change, which has become a buzzword amongst the 'Above', is a mixture of extremes. One group of academicians bases their postulates on three cornerstones which have been affected by the global warming: rising sea surface temperature; rate of sea level rise; and net erosion and accretion rates. While another group, points out that the change is minimal and that it is mostly the human-made factors that have done most damage to the islands. These two conflicting views among academicians have in turn divided policymakers and policy implementers down to the sub-divisional level. The believers of the climate change catastrophe have used this to justify inertia, or inaction, to help islanders cope with climate shocks with the theory that this is common for a coastal belt and that human settlements bordering the embankments should be evacuated. The debate among civil society, particularly the international agencies, is also pronounced and is increasingly being drawn along the lines of pro- and anti-conservationists. A section of the civil society, mostly belonging to the tiger conservation lobby, has forecast that a planned resettlement plan for one-third of the islands is urgently needed. Ironically, one of the reasons cited is that it is only the flora and the fauna that are the true inhabitants of the islands and are resilient to their climate and riverine topography. On the other hand, the islanders, whom the aforementioned section would probably wish to banish to some invisible territory, view what they term as 'weather change' through the lens of their daily chores and what affects their livelihood. Fishers would cite turbulent weather at unlikely times in the year, the farmers cite uncertain rainfall periodicity and frequencies, women are concerned about the rise in water levels during high tides which inundate their homestead ponds with saltwater. The meteorological office forwards the argument of increase in localised weather patterns. The debate on climate has been high on the agenda ever since cyclone Aila and the resultant attention of the outsiders of which even the women in the remotest islands are aware.

Obviously, it is the 'Below' which is the worst hit by livelihood uncertainty triggered by climate shocks, both big and small. There is a grudging acceptance by the 'Above' of the large scale migration due to

climate change, though the standard line of 'seeking greener pastures' is also attributed as a cause. The 'Middle' is aware of increasing trends of women indulging in hazardous fringe trades but lack of awareness of the 'Above' and the media has resulted in uncoordinated welfare and livelihood generation efforts not entirely synchronised with the community's demands and therefore serves little practical purpose.

The livelihood of the islanders, a vast majority of the 'Below', has perhaps been the worst hit by climate change. There is perhaps not a single house in the deltaic parts of the Sundarbans that have remained unscathed by Cyclone Aila. In some of the worst hit remote islands where the saline water sweeps into homes during high tide most male members between the age of 16 and 50 have migrated leaving behind the women to fend for the family. For these women, who are the most vulnerable and disadvantaged of the 'Below', depleting livelihood options and the daily threat to shelter seem to be not so much of concern as is the mustering of the little necessities that would keep them going each day. To an outsider they may complain about their precarious existence and uncertain future, but what really matters to them is the present and the myriad struggles involved in keeping alive.

Some of the 'Above' marvels at their resilient nature, others are mostly not aware of their existence. What is unique is that the resilience or a sense of stoicism manifests differently with age. Youths are increasingly migrating out to earn a livelihood but most of them come back during the harvesting season. The middle-aged to those bordering 60 years old shrug and get on with their life as most of them have lived with nature's fury since they were born. The seniors over seventy have seen more difficult times and they mention that their forefathers have had to deal with tigers, snakes, diarrhoeal outbreaks, starvation and were resilient enough not only to have survived but also raised their future generations. There is scope for further inquiry on the debate about whether the future generations would find certainty amidst the uncertainty due to climate change.

In the Sundarbans the debate of the 'Above', 'Below' and 'Middle' is not very unlike the mud layers that make up the fragile embankments. The complexity of the situation is heightened by the fact that there is scarcely any homogeneity even within one of the strata of 'Below', 'Middle' or 'Above'. The inherent divisions within the nature and density of the mud that is used to build the embankments find uncanny reflection in the discourse in the form of the naysayers and the optimists. And then there are the fence-sitters whose perception, like the ebb and flow of the tides of the rivers of this active delta, changes with every visible climatic shock and the times of not so visible climatic shocks.

9.2. Conclusions

This paper has analysed the perspectives of the 'Above', 'Middle' and 'Below' regarding climate related uncertainties in the Indian Sundarbans. It has demonstrated how climate change related impacts and uncertainties are increasing with time as documented by local people and through scientific data. For local people in the Sundarbans, uncertainty is not a new phenomenon in itself. It is part of life and has been so for many generations. Still climate change, and other anthropogenic interventions such as port development, commercial fishing and top-down government interventions, are increasing the vulnerabilities of local people. While marginalised people are constantly coping to variability and present ecological realities, they also have to live with the uncertainties arising due to forced displacement, difficulties in sustaining livelihoods and systematic government neglect.

For the poor and marginalised in the Sundarbans, there is a certainty in uncertainty. It manifests itself in the ever-changing rhythms of the river that gobbles up and creates new islands in the Sundarbans; the constant flooding of the embankments and periodic cyclones. While experts acknowledge that climate change is occurring, there are differences of opinion regarding attribution, that is, whether some of the changes are due to climate change *per se* or to other anthropogenic causes.

The repertoire of local people is rich and diverse with respect to climate change and uncertainty, which is also experienced in cultural terms (e.g. how *Bon Bibi* will take care of the islanders regardless of what may happen). While local people have learnt how to adapt to and cope with climate related uncertainties (e.g. embankments made with local materials in the Sundarbans), there are limits to adapting and coping with uncertainties caused by climate change.

In the Sundarbans, dominant pathways to deal with uncertainty and climate change are implemented by a top-down generalised plan which does not take into account the actual needs of the people, nor does it incorporate people's knowledge. As discussed, we found a tendency to control uncertainty instead of finding ways to live with or manage it in more locally appropriate ways (e.g. the politics and corruption around the concrete embankments). Uncertainty can also be an excuse to do nothing (cf. Dessai *et al.* 2007) as exemplified by the government neglect of the Sundarbans.

Overall we found that official knowledge from 'Above' tended to ignore the day-to-day experiences and practices of local people around uncertainty, thus missing out on local level detail. In the Sundarbans, despite the scientific uncertainty regarding changes taking place in the delta and how much of it can be attributed to climate change, dominant narratives tend to blame local people and their livelihoods for what is happening, while ignoring their intricate relationship to the geography and environment. Thus, local people are being left disempowered when options such as 'planned exit' (of the Sundarbans) are projected as realistic adaptation options. However, this is not feasible given the sheer numbers and India's very poor track record with planned resettlement. These 'decontextualised' top down policies can often hamper efforts to support locally appropriate and socially just adaptation.

However, despite the gloomy scenario highlighted, there are some seeds of change and emerging alternative pathways. There have been experiments between agricultural scientists (the 'Above'), NGOs and local people to bring back salinity resistant traditional paddy crops. These could bring about changes in the agricultural practices which can help farmers to build climate resilient crop production systems, especially those who have land which is not yet eroded. There are also similar experiments around culturing different fish and prawn species that can tolerate salinity. Similarly brackish aquaculture can be a sustainable option for the islanders as the market players like exporters, are showing interest in this alternative. While these alternative pathways can help build local resilience it is important that they are accessible and affordable to the poorest of the poor, especially in a region where most of the people are below the poverty line.

We hope that our study will allow scientists, researchers and policy makers to design and implement appropriate and socially just adaptation strategies for climate change in the Sundarbans. Empowering communities with information, technological skills, education and employment is the best way to address to reduce social vulnerability to cope with the climatic changes. The local observations described above provide a clear direction for future research, development planning and adaptation programmes that takes the interest and priorities of the vulnerable islanders as the starting point. It is important that a multiplicity of knowledge and approaches are deployed to address uncertainty and climate change in the Sundarbans in order to promote adaptation that responds to the local socio-ecological diversity and is socially just.

References

- Alam, R., Sarker, S. and Rahman, M. (2011) *Salinization of Inland Water System of Coastal Areas of Bangladesh Due to Climate Change*, conference paper, International Conference on Environmental Technology & Construction Engineering for Sustainable Development, 10–11 March 2011, SUST, Sylhet, Bangladesh
- Chakrabarti, R. (2009) 'Local People and the Global Tiger: An Environmental History of the Sundarbans', *Global Environment*, 3(2009): 72–95, <http://www.environmentandsociety.org/node/4614> (24 January 2018)
- Chaudhuri, A. B. and Choudhury, A. (1994) *Mangroves of the Sundarbans, Vol 1 India*, Gland: International Union for Conservation of Nature and Natural Resources
- Chowdhury, A. N., Mondal, R., Brahma, A., and Biswas, M. K. (2016) 'Ecopsychosocial Aspects of Human–Tiger Conflict: An Ethnographic Study of Tiger Widows of Sundarban Delta, India', *Environmental Health Insights* 10,: 1–29, <http://doi.org/10.4137/EHI.S24899> (24 January 2018)
- Chowdhury, A. N., Banerjee, S., Brahma, A., Hazra, A. and Weiss, M. G. (2013) 'Sociocultural Context of Suicidal Behaviour in the Sundarban Region of India', *Psychiatry Journal* 486081, <http://doi.org/10.1155/2013/486081> (24 January 2018)
- Chowdhury, A. N., Banerjee, S., Brahma, A., Das, S., Sarker, P., Biswas, M. K., Sanyal, D. and Hazra, A. (2010) 'A prospective study of suicidal behaviour in Sundarban Delta, West Bengal, India', *National Medical Journal of India* 23.4: 201–5
- Chowdhury, A. N., Mondal, R., Brahma, A., and Biswas, M. K. (2008) 'Eco-psychiatry and Environmental Conservation: Study from Sundarban Delta, India', *Environmental Health Insights* 2: 61–76
- Chowdhury, A. N., Shasmal, R. K., Ramkrishna, J. and Weiss, M. G. (2001) 'Eco-stress of human-animal conflicts in the Sundarban delta of West Bengal, India', *Eastern Anthropologist* 54:35–50
- Crate, S. A. and Nuttall, M. (2009) 'Epilogue: Anthropology, Science, and Climate Change Policy', in S. A. Crate, *Anthropology and Climate Change: From Encounters to Actions*, Walnut Creek CA: Left Coast Press
- CSE (2012) *Living with changing climate: Impact, vulnerability and adaptation challenges in Indian Sundarbans*, New Delhi: Centre for Science and Environment
- Danda, A. A., Sriskanthan, G., Ghosh, A., Bandyopadhyay, J. and Hazra, S. (2011) *Indian Sundarbans Delta: A Vision*, New Delhi: World Wide Fund for Nature-India
- Dessai, S. and Hulme, M. (2007) 'Assessing the robustness of adaptation decisions to climate change uncertainties: a case study on water resources management in the East of England', *Global Environmental Change* 17.1
- Ghosh, T., Bhandari, G. and Hazra, S. (2003) 'Application of a 'bio-engineering' technique to protect Ghoramara Island (Bay of Bengal) from severe erosion', *Journal of Coastal Conservation* 9.2: 171–178
- Ghosh U. and Lalitha, V. (forthcoming) *Child Health amidst Climatic Adversities in the Indian Sundarbans*, Brighton: Future Health System (Forthcoming, 2017)

Goffman, E. (1974) *Frame Analysis. An Essay on the Organizations of the Experience*, New York NY: Harper Colophon

Government of India (2011) *Census 2011*, http://www.censusindia.gov.in/2011-common/census_2011.html (24 January 2018)

Government of West Bengal (2010) *West Bengal State Action on Climate Change*, Kolkata: Government of West Bengal

Government of West Bengal (n.d.) State Irrigation and Waterways Department, Government of West Bengal website, <http://www.wbiwd.gov.in/> (9 February 2018)

Grant, S., Crim Tamason, C. and Jensen, K. M. (2015) 'Climatization: A critical perspective of framing disasters as climate change events', *Climate Risk Management* 10: 27–34

Hazra, S., Samanta, K., Mukhopadhyay, A. and Akhand, A. (2010) *Temporal Change Detection (2001-2008) Study of Sundarban*, Kolkata: School of Oceanographic Studies, Jadavpur University

Hazra, S., Ghosh, T., DasGupta, R. and Sen, G. (2002) 'Sea Level and associated changes in the Sundarbans', *Science and Culture* 68.9-12: 309–321

IPCC (2015) *Sixth Assessment Report*, Geneva: Intergovernmental Panel on Climate Change (IPCC), <http://www.ipcc.ch> (9 February 2018)

Iqbal, I. (2006) 'Towards an environmental history of colonial East Bengal: paradigms and praxis', *Journal of the Asiatic Society of Bangladesh* 50.1-2

Jadhav, S. K. and Munot, A. A. (2009) 'Warming SST of Bay of Bengal and decrease in formation of cyclonic disturbances over the Indian region during southwest monsoon season', *TheorApplClimatol* 96.3-4: 327–336

Jadhav, S. K. and Munot, A. A. (2007) 'Increase in SST of Bay of Bengal and its consequences on the formation of low pressure systems over the Indian region during summer monsoon season', *Mausam* 58: 391–396

Jalais, A. (2010) *Forest of Tigers: People, Politics and Environment in the Sundarbans*, Abingdon: Routledge

Jasanoff, S. (2010) 'A New Climate for Society', *Theory, Culture & Society* 27.2-3: 233–253, doi.org/10.1177/0263276409361497 (24 January 2018)

Jasanoff, S. and Wynne, B. (1998) 'Science and Decisionmaking', pp. 1–87 in S. Rayner, S. and E. L. Malone (eds) *Human Choice and Climate Change*, Washington DC: Battelle Press

Kabir, R. (2014) 'The impacts of cyclones Sidr and Aila on the health of the coastal people of Bangladesh', PhD thesis, London: Middlesex University

Kabir, R., Khan, H. T. A, Ball, E. and Caldwell, K. (2016) 'Climate Change Impact: The Experience of the Coastal Areas of Bangladesh Affected by Cyclones Sidr and Aila', *Journal of Environmental and Public Health* 2016. 9654753, <http://dx.doi.org/10.1155/2016/9654753> (24 January 2018)

- Kanjilal, B., Bose, S., Patra, N., Barman, D., Ghosh, U., Mandal, A., Vadrevu, L. S. and Sengupta, P. (2013) *How Healthy are the Children of Indian Sundarbans? The Sundarbans Health Watch Report Series 1*, Jaipur: Institute of Health Management Research (IIHMR)
- Kanjilal, B., Mazumdar, P. G., Mukherjee, M. and Rahman, M. H. (2010a) 'Nutritional status of children in India: household socio-economic condition as the contextual determinant', *International Journal of Equity in Health* 9: 19, <https://www.ncbi.nlm.nih.gov/pubmed/20701758> (9 February 2018)
- Kanjilal, B., Mazumdar, P. G., Mukherjee, M., Mondal, S., Barman, D., Mandal, A. and Singh, S. (2010b) *Health care in the Sundarbans (India): Challenges and plan for a better future*, London: Department for International Development
- Mehta, L., Srivastava, S., Adam, H. N., Alankar, A., Ghosh and U., Kumar, V. V. (forthcoming) 'Climate change and uncertainty from 'above' and 'below': perspectives from India', *Regional Environmental Change* (forthcoming 2017)
- Mitra, A., Gangopadhyay, A., Dube, A., Andre, C. K. S. and Banerjee, K. (2009) 'Observed changes in water mass properties in the Indian Sundarbans (Northwestern Bay of Bengal) during 1980 – 2007', *Current Science* 97.100: 1445–1452
- Mondol, A. B. (2011) *Sundarbaner Sekal Akal*, Kolkata: Rupkatha Prakasan
- Mukhopadhyay, A. (2011) 'Aila-struck Sundarbans', *Economic & Political Weekly* 46
- Mukhopadhyay, A. (2009) *Cyclone Aila and the Sundarbans: An Enquiry into the Disaster and Politics of Aid and Relief*, Kolkata: Mahanirban Calcutta Research Group
- Reeves, S. and Hodges, B. D. (2008) 'Qualitative Research Methodologies: Ethnography', *British Medical Journal* 2008;337:a1020 (on line)
- Rein, M. and Schön, D. (1993) 'Reframing Policy Discourse' in F. Fischer and J. F. Forester (eds) *The Argumentative Turn in Policy Analysis and Planning*, Durham and London: Duke University Press
- Ritchie, J. and Lewis. J. (eds) (2003) *Qualitative Research Practice: A Guide for Social Science Students and Researchers*, London: Sage Publications
- Rudra, K. (2010) 'The proposal of protecting Sunderban by the stronger embankment: Myth and Reality', *Refugee Watch* 35: 86–92
- Rudra, K. (2008) *The Encroaching Ganga and Social Conflicts: The Case of West Bengal, India*, West Bengal: Habra S.C. Mahavidyalaya College
- Samanta K., Hazra S. (2017) 'Mangrove Forest Cover Changes in Indian Sundarban (1986–2012) Using Remote Sensing and GIS' in S. Hazra, A. Mukhopadhyay, A. Ghosh, D. Mitra and V. Dadhwal (eds) *Environment and Earth Observation*, Cham: Springer
- Samsuddin, S. (2012) *Asani Grase Sundarbans*, Bengal: Ubudosh Publications
- SANDRP (2014a) *Sinking and Shrinking deltas: Major Role of Dams in abetting delta subsidence and Effective Sea Level Rise*, blog, South Asia Network on Dams, Rivers and People (SANDRP), <http://bit.ly/2FamMOH> (25 January 2018)

- SANDRP (2014b) *Lessons from Farakka as we plan more barrages on Ganga*, blog, South Asia Network on Dams, Rivers and People (SANDRP), <http://bit.ly/2Gh9lxA> (25 January 2018)
- Sarkar, A. (2011) *Sundarbaneritihās*, Kolkata: Rupkatha Prakasan
- Sen, A. (1992) *The Political Economy of Targeting*. Annual Bank Conference on Development Economics, Washington DC: World Bank
- Singh, O. P. (2010) 'Long term trends in the frequency of severe cyclones of Bay of Bengal: Observations and Simulations', *Mousam* 58: 59–66
- Singh, O. P. (2007) 'Long-term trends in the frequency of severe cyclones of Bay of Bengal: Observations and simulations', *Mausam* 58.1: 59–66
- Singh, O. P. (2002) 'Interannual variability and predictability of sea level along the Indian coast', *Theoretical and Applied Climatology* 72.1/2: 11–28
- Singh, O. P. (2001) 'Long term Trends in the Frequency of Monsoonal Cyclonic Disturbances Over the North Indian Ocean', *Mausam* 52.4: 655–658
- Sinha Ray, S. P. (2010) *Status of Ground Water Condition in Sundarban Area, West Bengal*, Commissioned Report, WWF-India
- Snow, D. A. and Benford, R. D. (1988) 'Ideology, frame resonance, and participant mobilization', *International Movement Social Research* 1: 197–218
- Walker, W. E., Harremoës, P., Rotmans, J., van der Sluijs, J. P., van Asselt, M. B., Janssen, P. and Krauss, M. P. (2003) 'Defining uncertainty: a conceptual basis for uncertainty management in model-based decision support', *Integrated Assessment* 4.1:5–17
- WWF (2010) *Sundarbans: Future Imperfect Climate Adaptation*, New Delhi: World Wide Fund for Nature
- Wynne, B. (2010) 'Strange Weather, Again: Climate Science as Political Art', *Theory, Culture & Society* 27.2/3: 289–305 doi.org/10.1177/0263276410361499 (25 January 2018)

Annex: Lists of Stakeholders

'Middle-Level' Stakeholders

Categories	Numbers
Local level administration and panchayat members of the village (lowest administrative unit)	4
Local Non-Governmental Organisations	8
Community Based Organisations (CBOs): <ul style="list-style-type: none"> • Fishermen's association • Farmers' club • Youth association • Self Help Group • Local club 	6
Journalists with knowledge of ground level realities	2
Ground level health workers: <ul style="list-style-type: none"> • Auxiliary Nurses and Midwives • Awanganwari workers, Integrated Child Development Schemes (ICDS) • NGO health workers • Doctors working in an NGO hospital 	8
Key Opinion Leaders <ul style="list-style-type: none"> • Rural Medical Practitioners • School Teachers • Rural Elite engaged in white collar jobs • Local Level activists • Political leaders 	6
Total	34

'Above-Level' Stakeholders

Categories	Numbers
Government Officials	
<ul style="list-style-type: none"> • Department of the Environment • Sundarbans Affairs Department • Department of Irrigation and Waterways • Department of Health and Family Welfare • Department of Forests • Meteorological Department • Disaster Management Officers • Sub Divisional Officers • Block Development Officers 	3 3 2 5 1 2 2 1 2
Scientists	
<ul style="list-style-type: none"> • Geologists and river scientists • Climate change specialists • Social Scientists working on the Sundarbans and environmental issues 	4 3 4
Donor Agencies	6
Total	38