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Research

Health threats of climate change: from intersectional analysis to justice-based radicalism

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ABSTRACT. Intersectional impacts of climatic changes are producing unforeseen physical and mental health challenges such as acute depression, stress, severe malnutrition, cervical cancer, sexually transmitted diseases for the poor and marginalized women and children. Conducted in the Indian Sundarbans, a social-ecological system critically stressed by climate change, this study disentangles, uncovers, and highlights obscured ways in which sudden and slow-onset eco-climatic shifts induced by climatic changes interact with existing patterns of social-ecological (mis)governance, gender inequity, power structures and struggles, therein, patriarchal policies and neoliberal markets. Coping mechanisms of the communities are shaped by complex, multi-layered, and scalar processes that involve institutional failures, private markets, and neoliberal governance patterns, which in turn are resulting in severely negative health consequences for women and children. Employing a justice lens and an agent-based coproduction of knowledge helps to move beyond the obscured causalities for specific health threats to foster an agenda for action. At the local scale, this framework identifies diverse and novel ways in which development policies and governance across domains must synergize to enhance specific capacities of women and children, allowing them to make right adaptation choices that bolster their long-term resilience. Theoretically, it uncovers how the global resilience agenda is increasingly being dominated by disaster capitalism that is producing negative health consequences at the local levels. Private capital, in conjunction with or through alliances with the state, identify weaknesses of resilience governance as profiteering opportunities and promote "adaptation" products and services through a hegemonic process. Despite producing maladaptation in the Sundarbans, the hegemony ensures that the pattern is reinstated and reproduced consensually. This pushed the responsibility of maladaptation into individual domains. Repoliticizing and affirmatively sabotaging this resilience design seems essential, which future studies should aim for.

Key Words: *children; climate change; gender; maladaptation; public health; resilience*

INTRODUCTION

Climate change is significantly threatening public health (Portier et al. 2010), in particular of the marginal communities, across the world (Portier et al. 2010, Patz et al. 2014, Franchini and Mannucci 2015, McIver et al. 2015, Watts et al. 2015, Berry et al. 2018). Both slow-onset environmental changes and extreme events induced by climatic changes interact with systemic inequalities, local social-ecological, economic, and cultural systems, described as intersectionality, that are producing serious health hazards for already disadvantaged groups. Few (2007) was among the first to suggest elaborate, expansive, temporally spaced, social science- and place-based studies to better understand the nature of intersectionality in specific systems that can help find entry points toward mitigating negative outcomes on marginalized populations and bolster local health systems. Intersectional analyses uncover different experiences and outcomes of the same phenomenon (climate change) by different segments of the population (women, children, the elderly, differently abled) despite sharing the same social-ecological living space (Oberhauser et al. 2017). Such analyses also identify which set of social, cultural, political, economic drivers interact with environmental changes, either collectively or individually (Oberhauser et al. 2017), to produce different kinds of vulnerabilities.

Although eco-climatic shifts are producing diverse health threats along the temporal and socio-spatial scales (Ebi and Boyer 2019), gendered and specifically targeted policies toward climate change adaptation and resilience-building on the other hand are poorly developed because of a lack of disaggregated and nuanced information (Rao et al. 2021, Roy et al. 2022). This study attempts to mitigate this knowledge gap through a two-step but cross-scale inquiry. First, by employing "a conceptual pivot to intersectionality," (Amorim-Maia et al. 2022) it uncovers grave health hazards for women and children originating from shifts in the lived environments produced by climate change while providing a deep understanding of the web of entanglements involving climate change and prevailing political, economic, social, cultural drivers. Second, by focusing on intragenerational justice, it identifies how and where local social-ecological governance can strategically build resilience of specific actors, in order to mitigate these negative impacts. Linking public health with the geophysical, agro-ecological, and socioeconomic factors (Sorensen et al. 2018, Rao et al. 2021) is important for the task. This study offers unique insights about cross-scalar recalibration of regional social-ecological governance that is not only cognizant of health resilience but also establishes an agent-based, scalable framework. This study aims to shift away from approaching health and climate change in a linear, technocratic, and instrumental way (Rao et al. 2021), and by developing an intersectional analysis, moves beyond and constitutes a justice-based, radical policy approach.

Conducted in the Indian Sundarbans (see Figs. 1 and 2), this study was originally planned to be carried out between 2017 and 2021. However, the fieldwork had to be suspended between March 2020 and April 2022 owing to the COVID pandemic. The Sundarbans is the world's largest and most biodiverse mangrove ecosystem, spanning 10,000 km^2 across India and Bangladesh. It is the "cyclone capital of India"[1] and a climate change hotspot (Hazra

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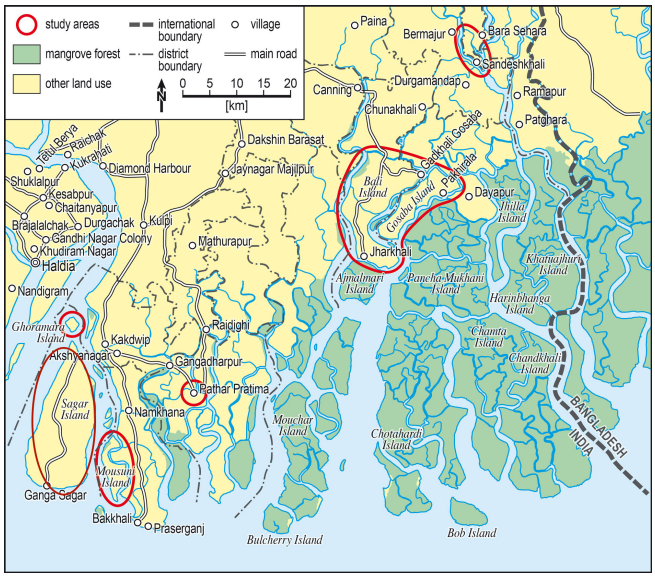
et al. 2002, Ghosh et al. 2015, Mondal et al. 2021), heavily impacted by "everyday disasters" (frequent extreme weather events; Ghosh 2018a:78) resulting in severe losses of cropland as well as forest and human inhabited land because of coastal and riverbank erosion (Ghosh et al. 2015, Samanta et al. 2021, Bandyopadhyay et al. 2023). Climate change is also producing critical ecosystem degradation by increasing salinity of soil and water, affecting livelihoods (Banerjee et al. 2013, Samanta et al. 2021) quite severely. Of the 4.5 million people who reside in the region, 2.5 million coastal inhabitants are the most vulnerable for being at the forefront of recurrent climatic and environmental shocks (DasGupta and Shaw 2016).

Fig. 1. Location of the Sundarbans in India with relation to Kolkata, the nearest megacity.

Fig. 2. Precise locations within the Indian Sundarbans where the fieldwork was conducted.



Epidemiological, quantitative, or cohort studies based on physical medical examination of select population groups or biological samples have been commonly conducted in the region (see Mukherjee et al. 2012a, b, Kanjilal et al. 2013, Mazumdar et al. 2014, Panda et al. 2016, Vadrevu et al. 2016, Chowdhury et al. 2017, Ghosh and Bose 2018). Although revealing the poor state of public health, these studies failed to explain how such conditions are produced and how entry points can be located to mitigate these emerging threats. As suggested by Mukherjee et al. (2012a, b), Paterson et al. (2014), WHO (2015), Barman and Vadrevu (2016), Banwell et al. (2018), Hossain et al. (2021), Amorim-Maia et al. (2022) and many similar studies, this work adopts an intersectional approach and situates the analysis into the global, regional, and local economic, political, and sociocultural processes to move beyond rhetorical nobility and challenge the dominant global adaptation discourse, norms, practices, and policies.

THEORETICAL APPROACH

Feminist geographers and political ecologists have underscored the importance of analyzing the intersectionalities to understand how differential vulnerabilities are produced and are incumbent upon prevalent inequalities and power relations in societies (Nightingale 2011, Tschakert 2012, Arora-Jonsson 2014, MacGregor 2017, Pearse 2017). Subjectivities of intersectionality, and the ethical dilemmas and injustices they reveal in transformative processes and specific (localized and context-specific) knowledge about how differential vulnerabilities are produced (Garcia and Tschakert 2022, Garcia et al. 2022) are critical to better understand the nature of newly emerging threats to communities, what solutions are needed, and how these must be planned and enacted in resilience practices (Garcia et al. 2022). Theoretically, we draw from feminist geography and political ecology to deconstruct power-laden processes of social-ecological governance (Tschakert and Tuana 2013, MacGregor 2017). We also draw from theories of medical anthropology, which advocates analysis of cultural determinants that helps identify how effective, targeted risk communication as well as public health measures in the selected setting can be designed (Rydstrom and Kinnvall 2019, Ortega et al. 2022, Singer et al. 2022).

These approaches caution against identifying any group as more (or less) vulnerable or relying dominantly on simplified assessments such as relations between eco-climatic shifts (caused by climate change) and vectors-borne diseases or heat strokes. These heavily risk resilience being subsumed by neoliberal market forces (already prevalent, see Reid 2013, Watts et al. 2015, Chandler and Reid 2016) and being dominated subsequently by techno-science fixes and market-based instruments such as insurance while the vulnerable and marginal groups continue to suffer (Taylor 2015, Oberhauser et al. 2017). The challenge is to uncover the very processes through which existing forms of vulnerabilities transform and produce new threats as well as how newer forms of vulnerabilities emerge (Jerneck 2018, van Daalen et al. 2020) through normative disruptions—to personal and economic life—leading to newer forms of gender inequality and unjustly designed resilience governance (Pearse 2017).

To better understand intersectionality of health outcomes, engaging with everyday social, cultural, ecological, economic realities of the subjects and their lifeworlds is necessary over a

protracted temporal scale (Jorgesen 1989, Schensul et al. 1999, DeWalt and DeWalt 2002). This not only provides a more comprehensive understanding of the processes through which vulnerabilities are produced but also synergizes theoretical and methodological approaches to move beyond the analysis and develop radical interventions into resilience governance (Mikulewicz et al. 2023). Understanding diverse situations and locating patterns requires contextualizing conditions and behaviors of people in these settings within which they act. We followed an inductive, comparative methodology to develop systematic guidelines for identifying, gathering, synthesizing, analyzing, and conceptualizing qualitative data for the purpose of theory construction following the principles of grounded theory (Glaser 2007). Following the principle of co-production of knowledge (Norström et al. 2020, Djenontin and Meadow 2018), we, especially in the second part of the study, focused on the worst vulnerable groups and their responses about solutions. This made our ethnography more analytic, interviews more in-depth, and helped develop a more robust analysis.

ETHNOGRAPHY IN A FRAGILE SYSYTEM

The Sundarbans is spread across India and Bangladesh. The Indian part is located about 90 km south of megacity Kolkata, comprises 102 islands (52 inhabited), coasts, mudflats, estuaries, riverbanks, and land interspersed with rivers, rivulets, canals, and brackish waters. Located in the mouth of the Bay of Bengal, it is part of the world's largest delta formed by the Ganges, Brahmaputra, and Meghna rivers. The region comprises the most biodiverse and the largest mangrove ecosystem in the world. It is a "backward region," as defined by the Government of India, with half the population earning under the $1/day (World Bank 2014). From being a subsistence economy based on agriculture, fishing, and natural resources such as honey (Ghosh et al. 2022), the region's economy has seen some growth with remittances by migrant wage laborers and more recently with domestic tourism (Ghosh and Ghosh 2019).

Understanding public health outcomes originating from the intersections of the physical environment changes induced by climate change, existing forms of structural violence, various power struggles, and neoliberal governments poses a methodological challenge. To overcome this challenge, the researchers lived in these villages for over six months every year between 2017 and 2000 (for the sites, see Fig. 2) with different sets of families, which allowed them the opportunity to observe their everyday struggles and negotiations with the ever-changing lived environments. Situated ethnographic observation and participatory action research allowed the researchers an intimate and nuanced understanding of the everyday hazards, socioeconomic and cultural practices, and resultant health impacts. The researchers immersed in the social, cultural, and ecological interactions across everyday spaces to understand and problematize socioeconomically, ecologically, and culturally constructed adaptive (or maladaptive) landscapes emerging from actor-structure-environment interactions. This helped uncover political and economic powers, inequality, and processes of marginalization that constitute the "critical realist epistemology" (McLaughlin and Dietz 2008), helping to understand causal processes.

We adopted a positivist-constructivist approach, cognizant of risks of being overtly "objectivist" (common in biomedical research) on the one hand and epistemological "paradigm wars" (Denzin and Lincoln 2018) on the other. With a postmodern approach, we acknowledged that individual stories can be rigorously researched as social-ecological worlds are conditioned by multiple processes, informed by multiple "truths," saturated with power relations, and always contextually situated (Cope 2009). However, these still represented mutual and contingent actions, thoughts, and interpretations of the researchers and the participants at a given moment and at a given place (Bryant 2017, Cope 2009). To address this, research questions were developed both deductively and inductively, refining these with reflexive cross-verifications and clarifications. Most works on the climate change-health nexus in South Asia continue to be framed in complex scientific and technical language, making it difficult to evoke a more fluid sense of climate change as a process affecting the lived experiences of people (Rao et al. 2021), which in turn motivates the neoliberal governance climate to ignore and obscure lived experiences, types of knowledge, access, and responsibilities (Nightingale 2011, Bee et al. 2015). Analyzing the nature of adaptation and access to resources is possible only by engaging with the everyday experiences and practices of negotiating through the complex labyrinths of power-laden social structures and biophysical impacts of climate change in the short and longer temporal scales (Demetriades and Esplen 2008, Ford et al. 2015).

METHODS

Ethnography, including interviews, focus groups, participation observations, and archival research produced data for the analysis. Interviews were conducted in natural settings, where words constituted data rather than numbers. This method emphasizes deep-seated understanding of a phenomena rather than seeking numerical legitimacy and helps avoid a zero-point epistemology or constructing knowledge from the perspective of the observer (Castro-Gómez 2021). The interviewers were both native speakers of the language of the region and well-acquainted with the sociocultural landscape. Interviews were conducted in the native Bengali language, translated into English. A gendered approach was maintained in the interviews: woman researcher interviewed women participants, away from the male gaze to encourage friendly, casual but intimate conversations. These interviews were conducted in various settings, sometimes when women cooked family meals, sometimes in the afternoon "gossip-time" under the cool shade of trees, or in the courtyards, riverbanks, jetties. Women were also accompanied during their household chores, livelihood and economic activities, and travels for participation observation. Male participants were interviewed by the male researcher across various settings. Data emerging from these interviews were compared to identify disjunctions and establishing causal connections. Interviews with experts, other stakeholders, and political actors were conducted by both the male and the female researcher. All the interviews were semi-structured in nature. Focus groups were conducted (for more details and the complete data, please refer Appendix 2) with women, the elderly, and children as mixed groups. These were organized through different times of the day but always in informal settings familiar to the participants.

Participants and place

Women interviewed were married and between 16 and 40 years of age, children interviewed were between 10 and 16 years old, and grandparents were between 45 and 65. The last group shared their experience of changes—ecological, climatic, socioeconomic, and geophysical—in the region. We also interviewed local

community members, health workers, informal healthcare providers (IHPs) called "quack doctors," and registered medical practitioners (RMPs), members of civil society who personally know the households and have knowledge about their health and social conditions, concerns, and aspirations. Apart from RMPs, "experts" included IHPs as well who provided every day and emergency health services across villages in the absence of institutional medical facilities and are revered as well as trusted by the local residents. The IHPs followed biomedical systems of medicine and not homeopathy, Ayurveda, or Yunani, other legal medical systems in India. People's faith on IHPs was based on their familiarity with the villagers, knowledge about individual problems and medical history, and most critically their availability in the times of crisis and emergency. Another group of experts were Accredited Social Health Activist (ASHA) workers, called *Anganwadi*, Auxiliary Nurse Midwives (ANM), who play the dual roles of social counsellors and biomedical observers who interact with and guide women (especially pregnant and lactating mothers) on issues of health and nutrition. ASHA workers visit every household in a village and are familiar with cultural practices of food across different communities. Ecologists, agriculture and fishery scientists composed the other groups of experts for their experience in conducting research in the region for over two decades. These scientists have consistently monitored and assessed shifts in eco-climatic patterns, quality of soil and water, distribution and changes in the floral and the faunal diversity. Interviews conducted with them helped understand how these shifts have impacted the lived environments for the humans and nonhumans, and the lives and livelihoods of specific communities and population groups.

RESULTS

The process of coding the qualitative data identified four themes across spatio-temporal scales but that intersected and interacted with each other.

1. Direct health implications: The first category unpacks direct health impacts of environmental changes that comprise slow-onset, eco-climatic shifts and sudden and recurring perturbations in the form of riverbank and coastal erosion, flooding and storm surges, and extreme weather events such as tropical cyclones.

2. Health impacts of autonomous adaptation: Eventual environmental changes produced at the intersection of climatic changes and anthropogenic activities compel communities to adopt varied coping and adaptation strategies or "autonomous adaptations," which are generally unplanned (IPCC 2007).

3. Policy and governance: Lack of synergy in existing developmental policies, power struggles in governance, and their entanglements, along with absence of targeted policies necessitated by sudden and gradual environmental shifts seem to further complicate the intersectional outcomes. This pushes the vulnerable women and children toward risky coping and autonomous adaptation choices, with significant consequences for long-term resilience.

4. Market-based solutions Market-based products and services offered in this complex landscape, promoted by the state and private capital either separately, in conjunction, or as a nexus, seem to problematize autonomous adaptation further in producing undesired health outcomes for vulnerable communities.

Frequent disasters and ecoclimatic shifts: food and well-being threatened

> *I used to put the rice on boil, then quickly go to the nearest canal, brackish water, rivulet with my gamcha*[2] to catch fish. Then I would just add the fish in the boiling pot of rice with some salt and other spices. But I do not get any fish here. So, I am forced to offer only rice, salt, and onions to my children on a daily basis. A 30-year-old, mother of three, on Satjelia Island

Traditionally, the daily meals comprised fish and rice in the region, with occasional pulses (lentils). Respondents revealed that edible fish were no longer available in the brackish waters, canals, shallow rivers rivulets that compose the "commons" in the Sundarbans. Lentils also do not grow anymore because the soil is too saline. Even rice, a staple food in the region, has gradually become harder to cultivate because of rising salinity, claimed local farmers. "Earlier our household rice production lasted one full year, we never purchased rice from the market. Now it barely lasts six months. The monsoon crop (second) is no longer possible," said an elderly farmer who was also a grandparent in Satjelia village. Input costs have increased even for subsistence farmers like him. "We now need more fertilizers and pesticides to grow rice and other vegetables. Regular erosion, inundation, cyclones, frequent storm surges, and subsequent crop failures have pushed us to extreme hardship. Farming is more expensive and rice needs to be purchased from the market," he said.

Frequent smaller perturbations or "everyday disasters" (Ghosh 2018b) along with three severe cyclones have seriously jeopardized availability of food. Widespread casualties of household cattle and poultry in these disasters have made milk and eggs unavailable for children (Table 1). "Disaster management focuses on saving human lives but death of livestock snowballs into long-term negative impacts on household health, particularly that of the children," said a grandfather in Ghoramara Island in western Sundarbans. The disaster cycle has critically affected a major source of nutrition for children: the mid-day meal[3] provided in the school. The meals are cooked onsite but the raw materials are supplied centrally, which during frequent disaster situations, become irregular. School buildings double up as disaster shelters in the Sundarbans as these are often the only concrete structures accessible for the locals. Frequent disasters have regularly forced schools to be suspended for indefinite periods. "Now every Perigean Spring Tides cause inundation and schools are used as disaster shelters. Not only the stored stocks of rice, vegetables, lentils, and eggs are damaged during the flooding events, new supplies also do not come," said a headteacher in Baliyara High School in Mousuni Island. "During these disasters children who live close to the coast or in low-lying areas are not able to attend even when the school resumes," he added. "This scheme has significantly improved health conditions of children and school enrolments while drastically reducing drop-out rates," said an ASHA worker in Baliyara village, Mousuni.

Inability to offer "good food" to their children produces a strong sense of guilt and emotional stress in mothers. "I feel terrible offering only rice and onions, sometimes potatoes, to my children and parents. My eldest son is a teenager, he feels always hungry. He has also grown very weak lately. When he falls ill, it takes very long to recover," said a mother in the island of Gosaba in the eastern Sundarbans. The rest of the family, especially the elderly,

Table 1. Direct health impacts of environmental shifts induced by climatic changes.

Type of eco-climatic impact	Physical health	Mental health
Gradual geophysical and ecoclimatic shifts (soil and water salinity, sea surface temperature, erosion, erratic monsoon):		
Many pulses, vegetables not cultivable anymore No fish in rivers, rivulets (backwater commons) Salinization of soil and sweet water ponds Quality of ecosystem services degrading Heatwaves affecting crop diversity	Malnutrition in children	Anxiety, agony, and emotional stress in mothers
Physical loss of land (river bank and coastal erosion), homestead, houses, infrastructure	Stress and strain	Emotional stress on all members of the family
Mega disasters (cyclones) and frequent smaller perturbations:		
Frequent crop failures Large scale death of livestock, no eggs or milk	Malnourishment	Psychological trauma and stress from economic losses
Irregular mid-day meals in schools		Stress from additional pressure on household
Recurrent losses and damages of life and livelihood	Fatigue, hunger, and strain	Psychological trauma and stress from economic losses, especially for women

often blamed women describing them as "incapable mothers," which added further stress to them. Frequent unavailability of one meal at school for children also increases household expenses on food in the recovery period, which affects both the quality and quantity of the meals that households could otherwise afford.

Young mothers from both upper castes and tribal communities are getting increasingly depressive, anxious, and tense with recurrent disasters, loss of property, destruction of homestead, and the challenges of rebuilding lives and livelihoods along with burden of other diseases. In Mousuni village, we found a quack doctor giving out psychiatric medications to young women. Differently colored capsules and tablets were put in paper sachets and given to these patients who complained of tension, anxiety, worry, sleeplessness. When asked, the person said that the women needed the support in calming their minds and to sleep well. "Hardships have increased manifold, it is simply too much for them to handle. They need the help of these medicines," he said. However, he was neither licensed to prescribe such medications nor should he have access to them. When we asked him if the women become dependent on these medicines, he said it was better than being perpetually depressive and anxious. However, biomedical medical practitioners said that extreme caution was needed with psychiatric medicines. "For teenagers, there must be a responsible adult at home to closely monitor the child. For adult women, we need to ensure that they do not become dependent on these or don't indulge in deliberate self-harm, the rate of which is already very high," said a doctor (MBBS, not a licensed psychiatrist) in Namkhana rural hospital. There is no psychiatrist in rural hospitals and MBBS doctors are not well-trained to prescribe such medications. "It is also critical that their general health, particularly reproductive health, is not jeopardized," said the lone psychiatrist in the largest government hospital of the region in Canning. However, he admitted that these medicines have penetrated rural areas with the collusion of a section of distributors, pharmaceutical companies, and local quacks, who feel obligated to help women in distress.

Coping mechanisms: harms intensified

Sale of household livestock, milk, eggs; catching crabs, prawns from the commons: economic stress to physical harm

Livestock worked as buffer capital for most families interviewed, which recurrent disasters forced them to sell in order to recover other material losses, in absence of institutional support. "There is no cattle or poultry left with us. Those which survived the recent disasters (Cyclone Amphan in 2020 and Yaas in 2021), we had no choice but to sell to repair the house, buy train tickets for traveling to Chennai[4] where my husband now works," said a 22-year-old woman in Sandeshkhali I Block. Married for seven years and a mother of two, she said offering milk and eggs to her children could not be among her priorities. Local healthcare providers, both formal and informal, interviewed across the region said that this was having a major impact on the nutrition of the children (Table 2). "Along with fish, there is now no milk and eggs for them. Neither are pulses and lentils growing locally. Thus, protein deficiency is acute among children and anemia in young women," said an IHP in Mousuni village in west Sundarbans.

Buying mobile phones, for connection and data to contact their out-migrating partners and / or family members as well as to be part of social networks for getting further information about work and for meeting the needs of entertainment were other expenses, revealed across focus groups. "My daughter-in-law buys mobile phone credits and saves for traveling with her husband once in two years to Chennai. Otherwise, she has to go to cyber cafes to talk with her husband over Internet which is much more expensive," said a grandfather in Jatirampur in Gosaba Island. The researchers also observed a proliferation of cyber cafes that charge exorbitant rates exploiting the desperation. An hour-long video call cost about Rs500 (US$6.50) for those who could not afford to invest in a regular data connection or smart phones.

According to young mothers, multiplying sources of income has become an absolutely essential responsibility for them as agriculture and fishing fail to yield, disaster losses accrue, and newer expenses (out-migration) arise. In situations of such desperation, accessing the commons was their only choice, which mainly included collecting prawn seedlings and catching crab. The former, most easily accessible without involving any illegality, was dwindling now. Catching crab, on the other hand, meant venturing into the protected forests. "This exposes us to tiger attacks and on top, punishments[5] if caught by the forest guards," young mothers said in a focus group. "These crab-catching trips are expensive; we need to organize, team up with the men and take along subsistence with us for a week or so for the trip. It cannot be done alone," said a middle-aged woman in Satjelia Island. A survivor of a tiger attack said apart from the risk it also involved paying in "kind"[6] to the forest guards if one wanted to avoid "legal" punishment.

Table 2. Intersectional health impacts of autonomous adaptation.

Forms of autonomous adaptation	Physical health	Mental health
Sale of household cattle, milk, eggs	Malnourishment in children	Agony and anxiety in mothers
Catching crab, prawn	Cervical cancer in women Physical stress in women	Anxiety from physical stress
Survival outmigration of couples	Physical stress among the elderly, grandparents	Anxiety and emotional stress in children, especially young girls
Survival outmigration of men	Sexually transmitted diseases for women	Anxiety and sense of insecurity among wives

Those who cannot join crab-catching trips, resort to collecting prawn seedlings from the rivers. "It is very strenuous activity. For over six hours I walk in chest-deep water on the riverbed and swim consistently, holding the fishing-net tight, to get a decent catch. I feel completely exhausted in the afternoon but it's some additional income to buy a health drink or biscuits for my children," said a 40-year-old woman in Sandeshkhali II village. But IHPs point out another grave risk that women fail themselves to recognize. Apart from the physical exhaustion, this practice makes women vulnerable to cervical cancer and other gynecological diseases. "Village quacks have no experience of diagnosing or treating such diseases. There is no Pap smear test [7] facility in the regional hospitals, we need to send samples to Kolkata," said an RMP in Dwariknagar Hospital, the largest medical facility in the Namkhana Block. The positivity rate, he claimed, has been alarming in the past few years, he added. "From 5 to 8% earlier, now over 60% of samples return positive," he said. Many women respondents in the interviews admitted experiencing vaginal discharges, but did not recognize it as a concern. "Since we are in the saline water for so long, it probably irritates the vagina leading to the discharge," explained a grandmother in her mid-40s who collected prawn seedlings regularly to cover the expenses of her granddaughter's upkeep as her parents lived and worked in Bengaluru, a city in the southern part of India.

Sexually transmitted diseases (STD) were newly emerging threats to young women, said interviewed RMPs and IHPs, at the intersection of multiple forms of vulnerability. While accessing forest commons often necessitated offering sexual favors to forest guards, extreme poverty made young women easy targets for human traffickers. "Many more women are now catching crabs for livelihood support, particularly after consecutive severe cyclones in 2020 and 2021," said a forest guard in Lahiripur village, in the eastern Sundarbans. However, the women crab catchers said that the patrolling forest-guards prey on them and demand sexual favors in exchange of a safe passage through the forest. "We generally have to comply, otherwise your boat and fishing gear are confiscated," said a 25-year-old mother in Sandeshkhali II. On the other hand, human traffickers exploited the vulnerability of the households. "Young mothers and girls are allured with the promise of work as housemaids in cities," said the head of a local NGO that works with the police in rescuing trafficked women. The other trap was promise of marriage to someone living in the mainland or in the cities. "Parents are even ready to pay a much higher dowry to get their daughters out of these islands. Though the one-time expense is higher, it is one mouth less to feed in the longer term," said an ASHA worker in the village of Sandeshkhali I in eastern Sundarbans. As a resident of the village who completed high school education, she said that outmigration of males was seriously affecting young women with sexually transmitted diseases including HIV. An IHP in Mousuni Island said, "Managing an increasing number of such patients is difficult without necessary medical infrastructure. Firstly, women avoid seeking treatment for the fear of social stigma. Secondly, we (IHP) are incapable of diagnosing and treating such ailments," he said.

Survival out-migration: intersectional impacts on physical and mental health

Two very severe cyclones in recent years (2020 and 2021), coupled with the COVID-19 pandemic, have escalated the breadth and extent of the commonest form of autonomous adaptation: outmigration. Key informants across coastal villages said that although earlier, mostly the men migrated, in recent times their wives have started joining them. "The recurrent losses from disasters are not easy to recover. But most of the brunt is borne by the young children, mostly teenagers, who are left behind in the villages," said a manager in an NGO that runs a school and a hostel facility for young adults in Pathar Pratima Block. We visited many of these children who now lived with their grandparents. "Long absence of the parents and their personalized care are making them extremely depressive. Grandparents are so over-burdened that they have become more vulnerable themselves with additional workloads such as farming, housework, fishing, childcare, and their education," said an IHP in Sandeshkhali II block.

Across all field sites, we visited many households where both parents have migrated to understand household conditions. It was found that the majority of these children were young girls in the age group of 7–16. Few boys living alone were generally older, in the age group of 12–18. A key informant in Path Pratima said that younger boys sometimes accompanied the parents. "Taking children along was very difficult for multiple reasons that included higher costs, compromised mobility, and concerns for safety," he said. We met a couple who migrated to the state of Tamil Nadu and was visiting home in Hingalganj, Western Sundarbans. Their 10-year-old daughter had been living with her grandmother for the last two years. The mother, busy cooking for the family and cleaning their house, which was locked for a year, said, "Safety of the girl was our primary concern. We work in the construction industry as wage laborers the entire day. Leaving a girl alone and unattended at home is very risky. She cannot be admitted to local schools as the free government schools teach in Tamil language. She has been studying in Bengali here, her mother tongue. She cannot adjust in a school in Tamil Nadu." When we asked, their daughter said that she missed her parents and eagerly waited for

their return. "I don't like it here alone. My grandparents do everything possible for me but they are old and I cannot harass them or ask for things I like," she said. Her grandfather, taking us away from her, said in a whispering tone (not to be audible to the girl), "She does not eat well, either watches TV or the mobile phone her parents gifted her all the time. She sits by the window for long hours and has lost interest in studies too."

We met a 13-year-old girl in Bali II Island who lived with her grandparents while her elder brother accompanied her parents who worked in the Andaman Islands, south-east of India in the Indian Ocean. Her aunt, newly married to the girl's uncle, said that the girl was sad all the time. Just 17-year-old herself, she seemed visibly uncomfortable with the responsibility of her newfound niece. The girl, said the aunt, lived in a "cocoon." "She never has any appetite and often dozes off while watching television in the evening, after she returns from tuition classes." A nine-year-old boy we met in the hostel in Pathar Pratima said he desperately longed to be with his parents who lived in New Delhi, the capital of the country. "It is such a wonderful city, so big, with large buildings and cars. I hate living in this 'primitive' village," he told us.

RMPs interviewed across all sites said that there has been a significant increase in depression and anxiety among children in the region (Table 2). "There was hardly any case earlier of mental ailments. It is not even a factor of better detection as I have been medically examining these children though routine immunizations and inoculations," said an RMP in Rangabelia Hospital in the Eastern Sundarbans. "These mental conditions affect appetite and digestion process, and in turn aggravate malnutrition. In the absence of parental supervision, children are not eating nutritious food. Then ready availability of pocket money provided by parents, almost as a compensation for their absence, is pushing them toward alluringly packaged and junk food with no nutritional value," said an RMP in Sagar, the largest island in the Sundarbans with only state-run hospital with an assigned psychiatrist. These are advertised widely in the outdoors locally, we found, even in the remote areas. "Television and social media are other main sources of this kind of promotional materials. Parents as well as children think that these are good for their health and well-being because these products are widely consumed in the cities," said a pediatrician in Dayapur rural hospital in Namkhana. Children who lived with their grandparents tried finding solace and comfort in television and mobile phones, he said, which harmed them further. "They lose appetite and suffer from insomnia and are convinced of the benefits of such food items," he said. A grandfather in Pathar Pratima lamented to us that his granddaughter comes back home after tuition, starts watching TV and falls asleep without even having dinner. "Even when she eats, she watches TV," he said, which the doctor said affected digestion acutely. "And the cycle goes on," he lamented.

Policy and governance failures: threat multipliers

High level of autonomous adaptation as found in the community underscores poor or even missing institutional responses to the slow-onset and sudden biophysical shifts. First, communities reported little support from the existing governance instruments such as the national income guaranty scheme, producing further financial insecurity as well as physical stress. Second, emerging policy responses from the state and governance toward local economic development seemed not only to aggravate existing health threats but produce new ones.

No livelihood support for women: failure of income guarantee schemes

Despite being branded as the "largest adaptation programme in the world" (Ghosh 2018b), the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGA)[8] seems to have failed the local population, women in particular. "100-day work is just labor intensive such as digging canals or ponds for eight hours a day (without food) for Rs271 (US$ 3.75) and is the only available work[9]. After managing the household that includes sourcing raw materials, cooking, feeding children, doing other household chores, it is impossible for us to do such physically demanding work for eight hours at a stretch," said a mother of three in Gosaba Island. "Also, despite our job cards, there is much favoritism over political colors and bribery," said a woman in Lahiripur, one of the remotest inhabited islands in the Sundarbans. Crab-catching on the other hand, offered flexibility for being carried out between 5am and 10–11am. "We can come back, take a little rest before engaging in the household chores. The return is higher as well," said a woman in Sandeshkhali village who, after working in the NREGA for a few days, went back to collecting prawn seedlings and catching crab. "We would have greatly benefitted from it if 100-day work could offer women-friendly work, but it never has," said a grandmother in Gosaba who is the custodian of her 13-year-old granddaughter after her son recently got killed in a tiger attack and daughter-in-law heavily injured.

MNREGA has failed to produce adaptation co-benefits because the local administrators have largely failed to reimagine the program (Table 3). "The nature of work offered under NREGA must be specific to the ecosystem and the demography. Because most men migrate out to work from the Sundarbans, the nature of work should be women-friendly, which has never been given a thought," said a Panchayat member in Rangabelia who also works as a para-teacher in a local school. Digging soil for ponds and roads cannot be done by women and there is a limit to it as well, said the block development officer in Mousuni Island. "We are trying to collaborate with the forest department so that new kinds of work can be developed in this specific ecology. It can be in afforestation projects, conservation efforts, or something similar. But there are many bureaucratic hassles and conflicts over jurisdictions, authorities, and even mandates," he said.

No support to local entrepreneurs in ecosystem

Promoting ecotourism has been a major institutional policy for the past decade or as an instrument of local area development. The region is now dotted with over 45 such facilities, all privately owned except one, which the state defines as an attempt to provide alternative, non-nature based livelihoods to local residents. Our key informants said that the locals were selling their land to ecotourism companies that were making lucrative offers to them. In the interviews we asked if they could instead forge partnerships with these corporations or even develop these facilities on their own or through cooperative societies. In an interview with a family who just sold their land in Pakhirala, the ecotourism hotspot for

Table 3. Intersectional health impacts from policy and governance failures.

Institutional misgovernance	Physical health	Mental health
No livelihood support, income guarantee for women Ecosystem degradation from ecotourism (Pollution in the water, air and land from diesel, plastic, noise, chemicals)	Physically intensive, stressful work for women Acute health impacts, from skin to nutritional, for general population	Agony and anxiety for women Sense of loss and deprivation

its proximity and easy access to the Sundarban National Park, we learned that the companies were not interested in such arrangements. "They always insisted on outright sale because they do not want to go through such hassles and give up control on what they can and may not be allowed to do," said the landowner. The state also did not encourage or promote local entrepreneurship (Table 3). "There is no support from the local government, either credit facilities or support. On top of that, we have to collude with the local political interests. They ask for their share in everything, be it construction contracts or services such as food or travel. If we do not comply, they make it impossibly difficult for us to do business here," said the manager of a local bank who would avoid investing in any such venture started by the locals. As a local resident, he also sold his land and joined the bank. "I was extremely lucky I found this job, but most people exhaust the one-off payment they receive in funding relocation, paying off debts and so on. Often they fail to save enough for their future," he said.

Problematizing market-based solutions (services, products): jeopardizing long-term resilience

The market and private capital have become an important collective actor in the Sundarbans, beginning with ecotourism and extending to the food industry, agriculture, and entertainment, all of which seem to be producing undesirable and dubious health outcomes in the region for the entire population but in particular for the children.

Chemicals flowing from increased tourism and intense agriculture

There seemed very little ecological component in the tourism to support the claim of ecotourism, revealed by the fieldwork. Pollution and ecological degradation appeared widespread, in the form of plastic, fossil fuel, and chemicals. Doctors identified heavy metal pollution in the river waters (paint from the boats and other built structures) along with diesel and kerosene as key drivers of an increase in the rate of cervical cancer in women who collect prawn seedlings (Table 4). In particular, plastic in different forms, from bottled drinks to packaging and various forms of microplastic, along with increasing sea surface temperature, has forced the commercially viable fish to move into deeper, less polluted waters. "Only trash fish that can survive this level of toxicity are now left in the shallow waters," said a fishery scientist at the Central Inland Fisheries Research Institute, Indian Council of Agricultural Research. Diesel from the boats and generators, along with industrial waste flowing downstream from construction activities are polluting the water and air, sharply increasing emission but noise pollution has also significantly increased," said a member of the West Bengal Pollution Control Board. A forest officer in Bali I, where many of the tourism facilities are located, said, "Semi-mechanized boats running on old engines, diesel generators, loud music played by tourists are the main sources of noise pollution. Water pollution is killing the aquatic animals including the rare river dolphins. This in turn affects humans when they consume fishes that have high levels of heavy metals in their bodies." Locally, cancer didn't used to be so prevalent, said one of the most senior medics in the region in Rangabelia village in Gosaba. "Apart from cervical cancer in women, the prevalence of cancer is quite high in men as well now," he said.

Table 4. Intersectional health impacts of disaster capitalism.

Solutions from neoliberal nexus	Physical health	Mental health
Chemical pesticides and fertilizers	A variety of skin and lung diseases for both men and women	Agony and stress from previously "unknown" physical ailments, loss of man-days
Ultra-processed and packaged food	Acute malnourishment, lack of concentration in children	False sense of well-being

Recurrent disasters including floods, land erosion, storm surges, and inundations have been producing frequent crop failures. In the guise of helping farmers, agrochemical companies heavily advertise and push sales of chemical pesticides and fertilizers (Table 4). "Crops fail much too frequently nowadays. On top of that, increasing salinity in the soil is making traditional crops uncultivable," said a member of a farming cooperative in Sagar Island. A scientist at the Bidhan Chandra Krishi Viswavidyalaya [10] who has worked in the region, said that the chemical fertilizer and pesticide industry has seized this crisis as an opportunity. "Farmers prefer these chemicals over biopesticides (such ducks or certain varieties of fish in the rice fields) as companies promise magically higher yields," he said. After a period of continuous use, these chemicals have polluted the soil and made it less fertile. These chemicals have also contaminated groundwater, he said. During flooding, water from the agricultural fields spill over to local sweet-water ponds, producing the worst and immediate harm for the locals, said an RMP in G-Plot village, Pathar Pratima. "Women wash utensils and clothes in these ponds, the water is often used for drinking. Children swim here. Both children and women are suffering from these chemicals," he said. Contaminated groundwater has made deep tube-wells, the other source of drinking water, unsafe, said an IHP in Mousuni. "Acute diarrhea from drinking contaminated water is now widespread. Apart from malnutrition, it is causing more complicated ailments never found here," he said.

Interestingly, a majority of the farmers interviewed were aware of the detrimental effects of chemical pesticides. A farmer in Satjelia Island said: "Commercial farming of okra and eggplant now need intense chemical pesticides," he said, showing us another small plot of land with okra and eggplant, "and this is for our

own consumption where we do not use any of these chemicals." These pesticides and fertilizers have completely destroyed traditional crop varieties, especially rice, said an agrologist and geneticist. "There were traditional salt resistant varieties in the region, those with medicinal properties used during fever and flu and pest resistant ones. Government's push toward cross-bred, high-yielding varieties clearly shows the nexus between the state and the chemical industry, as yield of these crops depends on these chemicals, which in turn are jeopardizing both human health and that of the ecology," he said.

Ultra-processed and packaged food: ready alternatives to food shortage?

While climatic change, pollution, and frequent disasters impact the quality, variety, and availability of essential food items, we found the local grocery stores full of various kinds of packaged, processed, and ultra-processed food and beverages that include aerated drinks, ice creams, various health drinks, candies, instant noodles of different kinds, biscuits, chips, and different types of snacks. Across all sites, interviews with the children and their mothers, owners of these grocery and stationary stores confirmed the popularity and penetration of these food items. Both RMPs and IHPs across field sites said that children not only found these tasty and aspirational as targeted advertisements flooded the television and social media but mothers trusted the majority of such food items as "beneficial" for their children (Table 4). In one of the interviews in Bali II with a mother of two, a boy of 10 years and a four-year-old younger daughter, said that she firmly believed in the additional food value as well as health benefits of a leading health drink supplement (Table 4). "These are consumed by educated and rich families in the cities. You cannot argue against this, can you? Are they all stupid?" she retorted when we attempted to explain to her that regular, nutritious meals might be more important.

Grandparents interviewed narrated a different story. According to many of them, otherwise stressed mothers did not worry about cooking and these food items offered them the freedom not to. A doctor at the Sandeshkhali Rural Hospital said that widespread consumption of these food items further compromised nutritional status of children. "Firstly, the majority of these products are laden with harmful chemicals in the form of preservatives and additives, which affect the internal organs as well as the brain of the children. Secondly, consuming these drives them away from main meals, which develops into metabolic disorders," she said. Smart packaging in smaller portions that made these cheaper and affordable were another strategy food companies adopted. "It has become the quick and cheap solution for the mothers," said another doctor in Sagar Hospital. The classic example, he said, was biscuits. "Biscuits have no food value but TV advertisements have created a myth that these can replace milk. On top of that, these are now available in smaller packs of Rs5 (US$0.06), making it easier for the parents, grandparents to afford," he explained to us.

DISCUSSION

Disentangling intersectional health impacts of climate change

Table 5 summarizes what kinds of unforeseen health threats are being produced in a social-ecological system stressed under the influence of climate change and Figure 3 explains the intersectionalities that are producing these threats. This informs the key aim of this study to better understand how drivers from different domains were interacting, threatening public health and making specific groups more vulnerable than others. Theorizing these complex entanglements for the purpose of simplification and universality, Figure 4 explains the scalar nature of these intersectionalities in producing these threats, beginning with direct impacts, which produce first order impacts, followed by autonomous coping mechanisms that produce second order impacts. Third order impacts are produced by various patterns of local area governance that are in turn products of existing policies or the lack of it. The snowballing of impacts across scales culminate into the eventual health impacts as demonstrated in Figure 4, following the theoretical structure of "chains of explanations" proposed by Blaikie and Brookfield (1987). This scalable analytical framework, we believe, should inspire future research to examine how seemingly disparate and obscured aspects (fast food, for example) can shape maladaptation, providing better insights into the interaction of climatic and non-climatic drivers.

Table 5. Range of unforeseen health threats of climate change in the Sundarbans.

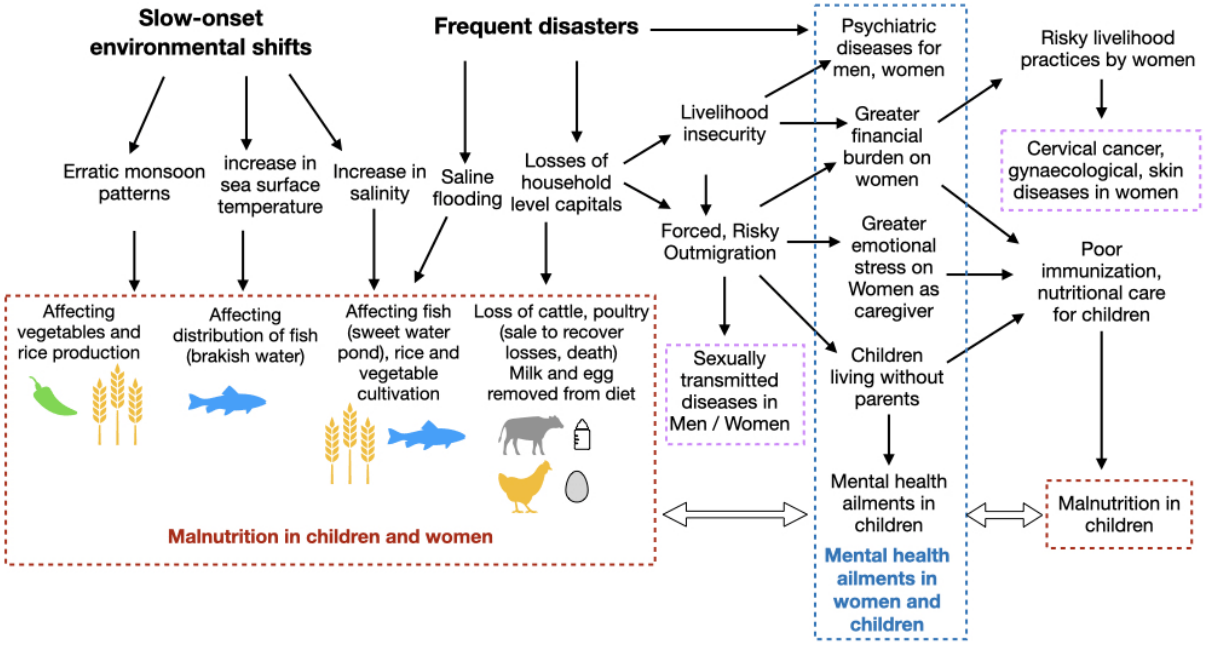
At a glance: intersectional health impacts of climate change for women and children	
Physical health	Mental health
Acute malnourishment	Anxiety and fear
Lack of concentration (in children)	Agony and stress
Skin diseases	Acute depression
Lung diseases	Sense of guilt
Cervical cancer	Sense of doom and gloom
Sexually transmitted diseases	Despair
Physical fatigue	Helplessness and sense of vulnerability

However, in order to address the forms of maladaptation, the study moves beyond being just an intersectional analysis and employs justice as an analytical framework toward fostering action across scales. Although climate change mitigation needs concerted and collective global action, local misgovernance, power struggles over extraction, workings of remotely located capital, along with social, political, and economic drivers make local (health) impacts of climate change far more acute (Ravera et al. 2016, Cianconi et al. 2020, Erwin et al. 2021). We propose a two-step mitigation strategy: first, employing a framework of intragenerational justice and coproducing knowledge to uncover synergies between (often) seemingly unconnected policy domains, and second, by resisting the neoliberal, market-based, and hegemonic resilience agenda that offers disguised solutions and produces maladaptation from below.

Moving beyond intersectionality to justice

This study employed an intersectional approach to understand how health risks of climate change were evolving in the Sundarbans following recent works (see Kaijser and Kronsell 2014, MacGregor 2017, Myers et al. 2017, Pearse 2017, Berry et al. 2018, Simon-Kumar et al. 2018, Clayton 2020, O'Neill et al. 2020, Geng et al. 2021, Harville et al. 2021, Wang et al. 2021). It successfully uncovers multiple dimensions of vulnerability such as workings of power (Garcia et al. 2022); ethical dilemmas and injustices within transformation efforts (Garcia and Tschakert 2022); entanglements of social, political, and economic structures

Fig. 3. Scalar nature of intersectionality and their entanglements, threatening vulnerable groups with acute health hazards.



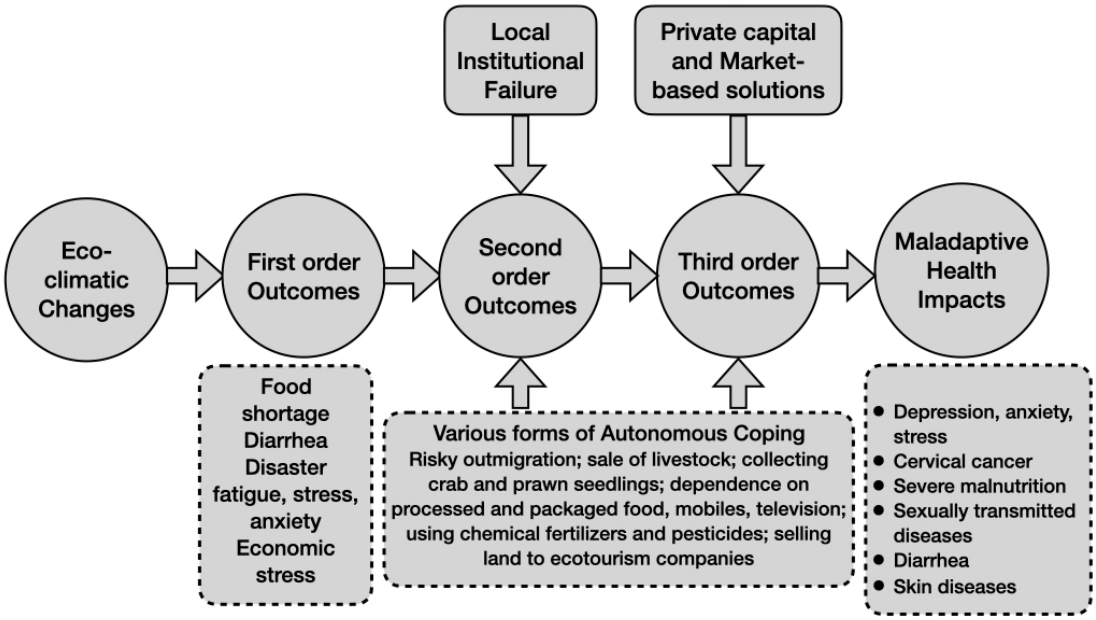
that produce unequal adaptation opportunities (Erwin et al. 2021); deconstructing power structures that manufacture differential climate vulnerabilities (Zoll et al. 2023). However, intersectional analyses risk being temporally indeterminate, rhetorical, and normative, what Cote and Nightingale (2012:480) describe as an attempt to get "the rule right." We attempt to employ our findings to develop an agenda for action that can help address the production of the health threats. The findings uncover the need to change the indicators where necessary as Watts et al. (2017) had urged, underscoring requirement of tools and parameters that are currently missing to tackle uncertainty and obscurity of scaled impacts (for example, how disaster capitalism produces stressors disguised as solutions). If addressing the negative health impacts of climate change remains the priority and focus, a justice-based framework (Sen 2012), we argue, can potentially help identify specific capacities (Nussbaum and Sen 1993, Assaduzzaman et al. 2023) at the local levels and theoretically challenging the obscured ways in which global resilience governance is increasingly being dominated by market-based approaches. This helps to better understand the nature of reforms needed in the local and global resilience approaches as well as how to recalibrate local social-ecological governance considering multiple realities of the entangled social-ecological worlds that make and unmake coping and adaptation for the most vulnerable.

Agent-based, scalar approach to develop capability and foster choice: recalibrating policy and governance at the local scale

Autonomous adaptation, as the study finds, is context-specific, emerging from locally available resources and access to the same, local socio-political, cultural, economic, and ecological properties. In the Sundarbans, much like observed elsewhere (see Rahman and Hickey 2020), these activities produced unintended consequences or "maladaptation" where vulnerabilities shift from one group to another and from one time scale to another (Juhola et al. 2016, Ishtiaque et al. 2017). For marginalized women in the Sundarbans, enhancing "capability," drawing from capability theory of Nussbaum and Sen (1993) could in theory, help address maladaptive health outcomes. In a similar study conducted in the adjoining coastal areas of Bangladesh, Assaduzzaman et al. (2023) point out that offering women "freedom of choice," again a Senian concept (1999), is key, which a justice framework strongly suggests.

The idea of "capability" however, is significantly nebulous, characterized by high levels of subjectivity, definitional challenges, and lack of specificity for the actors in question for which the capability project risks being temporally indeterminate (Clark 2005, Dean 2009, Pogge 2010). Building capability of the marginalized population in the Global South often resembles colonial practices of "othering" through "remotely orchestrated, far-flung, and heterogeneous project(s)" (Chakravorty-Spivak 2012:280) as well. Co-producing knowledge in an agent-based framework can help overcome these challenges. Although intersectional analysis deconstructed how women were becoming vulnerable to cervical cancer, how policy and governance can address these intersecting vulnerabilities from across domains remains obscure. Women in the Sundarbans, however, were quite precise in their response, that the existing 100-day work scheme could be the most effective form of support for the mothers and grandmothers. A gender-sensitive job guarantee scheme would provide them with economic and critical livelihood support for

Fig. 4. Deconstructing the complex intersections of climatic and non-climatic drivers through first-, second-, and third-order outcomes that then produce eventual health threats for the vulnerable women and children. This helps identify where to situate local policy reforms and recalibrate governance, while resisting misappropriation of the resilience agenda by power struggles at a meta level.



which the only available choices currently comprised catching crab or collecting prawn seedlings. Many mothers, however, pointed out that for their children, daughters in particular, the form of capability was education and leaving the Sundarbans once they were capable with skills and trainings suitable for different industries.

This is a two-step process. The intersectional analysis uncovered embedded power relations, assumed gender roles and patriarchal ideas of family welfare in the regional and local governance that make the income guarantee scheme unsuitable for women. At the next level, a just, co-produced knowledge linked two seemingly independent phenomena (cervical cancer in women and poorly designed income guarantee scheme). Identifying new formations of institutional arrangements or synergizing with the existing ones (such as a job guarantee scheme in this case) linking the geophysical, the ecological, and the socioeconomic is essential to develop gender-sensitive policies and support mechanisms (Rao et al. 2021). By recognizing such synergies, an agent-based co-production of knowledge helped develop "essential vocabularies of the global movement for justice" (Martinez-Alier et al. 2016). Epistemological shifts and legitimizing diverse ontologies seem essential to address emerging forms of health injustices and newer health-related vulnerabilities within temporally determinate and spatially defined (local) scales. Climate (and social) justice, by nature, is deeply intra-generational as opposed to the condition of intergenerational that defines sustainable development and its goals (SDGs).

Vulnerability is often treated as an anomalous condition to intervene upon and resolve (Taylor 2015); putting the interests of the vulnerable in the forefront helps understand contextual pathways of action for a diverse set of different actors. Although multiple structural drivers make different groups of women differently vulnerable, as Djoudi et al. (2016) found in their study, policy actors need to provide "solutions"[11] that overlap these multiple structures and realities. For example, mothers in three different kinds of households—with migrating young male members, those with local migration or no migration (mostly tribal), and finally where husband and wife both migrate—are subjected to very different socioeconomic, cultural, political, and climatic stressors. Similarly, mental health conditions emerge very differently across different households and originate from diverse interacting domains, however, policies must be situated at a precise intersection, overlapping diverse conditions, which is significantly under-researched (Hayes and Poland 2018, Stone et al. 2022). Figure 3 disentangles the intersections across scales, identifying common, scaled goals and actions along specific temporal and spatial scales and thus offers a framework for action that provides access to different but contextual information, facilities, services, and incentives at different scales and can create empowering environments (Ihalainen and Sijapati Basnett 2015, Assaduzzaman et al. 2023), strengthen agency (Andrijevic et al. 2020), and facilitate individual choices.

Misappropriation of resilience by the market: resisting disaster capitalism through a radical repoliticization agenda

Focusing on the workings of power and understanding how they transcend from the global to local levels to produce vulnerabilities of specific communities on the ground (Ahlborg and Nightingale 2018) remains crucial. In the Sundarbans the private capital is forging complex nexuses with institutions, the state, and the media across scales to misappropriate resilience in particular and development in general. Although it is increasingly been critiqued at a theoretical level (see Chandler and Reid 2016, Mahdiani and

Ungar 2021, Garcia and Tschakert 2022, Goldstein et al. 2023, O'Grady and Shaw 2023), this study offers specific instances of and insights into how disaster capitalism (Klein 2007) not only shapes autonomous (mal)adaptation but does it consensually. In the earlier section, we stressed fostering freedom of choice, but deconstructing wicked ways in which autonomous adaptation choices are facilitated and shaped is also important. This resembles the Gramscian idea of hegemony that involves alliance of large corporations, private capital, and the state, through the mass media (including social media), to produce instruments of domination in the forms of cultural tools that serve as authority. Without coercion or repression, communities (women and children) choose tools because of the affirmative, positive, and universalizing nature of lifeworlds these persuasively promote. Climatic changes have created a disaster continuum in the Sundarbans that comprises small and mega disasters, pushing the women and children to the limits of their resilience from which neoliberal markets and the state identify opportunities of expansion and consolidation, for example, the free availability of psychotropic medicines and their distribution without prescription. The market, identifying increasing agony, anxieties, and depression owing to recurrent disaster losses and risky migration, pushes products that, in the guise of solutions, produce serious harm, threaten public health apart from turning the maladaptive over a temporally expanded window.

Although Klein's (2007) assertion that a sudden shock from a disaster facilitates corporations and the state to pursue with unfavorable policies, the Sundarbans experiences a significantly different form of disaster capitalism. Slow-onset environmental shifts produced by climate change coupled with intermittent localized disasters seem to offer consistent and more invasive opportunities for the state-market nexus to operate in a temporally and spatially obscure manner. The disaster continuum produces significant fatigue where ultra-processed, packaged food and beverages offer significant temporary reprieve. However, on the temporally expanded scale, these have clearly been maladaptative for children: 551 out of every 1000 children are undernourished (World Bank 2014), despite significant decrease in poverty and increase in disposable income, corroborated by Dutta (2016) who found a significant household level increase in the spending on junk food.

Ecotourism is another of instrument posited institutionally as an effective community resilience. However, Ghosh and Ghosh (2019) found that of all the ecotourism facilities (over 30) in the Sundarbans, only one was owned by a local community member. This present study also found little socioeconomic benefits, i.e., local employment and small businesses, for the region, its communities and households from these investments. Similarly, chemical fertilizers and pesticides, promoted by corporations and the state for enhancing crop yield, pollute the soil and water, causing ecosystem degradation across scale. The nexus between high-yielding varieties of crops, often promoted by the state and the chemical industry, work in conjunction, which has led to extinction of many traditional varieties possessing various climate resistant (draught, flood), medicinal, and other properties (Deb 2017). Widespread consensus in the community on tools such as ecotourism, chemical pesticides, junk food, or indiscriminate psychotropic medication not only produce severe undesired and negative consequences but also push the responsibility of this maladaptation into individual domains (Watts et al. 2015). An assessment of relevant adaptation projects (between 2016 and 2020) that aimed to reduce exposure, risks, and vulnerabilities to climate change found that these did not enhance gender equality in any form (Roy et al. 2022). Over-reliance on the market-based solutions and instruments seemed to have little impact on structural inequalities resulting from historical marginalization and often exacerbated unequal outcomes for the most vulnerable (Roy et al. 2022) such as women.

Maladaptation seems to shape outcomes of primary adaptive tools, and "rebound" and "shift" vulnerabilities to a different domain (Juhola et al. 2016), establishing negative correlations between climate change adaptation choices, interventions, and outcomes (Roy et al. 2022), producing newer forms of health threats. The findings of the study urge simultaneous top-down interventions and bottom-up grassroots-level action in the form of politics based on rights and justice, challenging the dominance of business-as-usual adaptation approaches. Top-down approaches must critically analyze how privatized development processes, in the guise of solutions (services or products), are producing maladaptation despite the elusive nature of political definitions and associated difficulties to apply it in different social-ecological contexts (Juhola et al. 2016). Bottom-up approaches underscore the need for locally designed radicalization of the resilience agenda, urged by the works of Amorim-Maia et al. (2022) in Spain, Erwin et al. (2021) in Peru, and Rahman and Hickey (2020) in Bangladesh. Our study, we hope, provides a framework for how this radical agenda can be pursued at both the global and local levels.

CONCLUSION

Climate change is snowballing into a public health crisis, severely affecting marginalized women and children in particular. Conducted in the Sundarbans, one of the regions worst affected by climate change, this study shows how the interaction of slow-onset, sudden environmental shifts (induced by climatic changes) and political, economic, social, and ecological drivers are culminating into health threats such as cervical cancer, mental health ailments, and severe malnutrition in women and children through a complex process. First, frequent disasters and slow-onset environmental changes are directly compromising availability of food and mental health challenges. At the next level, autonomous coping mechanisms of the vulnerable are further compounding food shortages, aggravating malnourishment and acute stress on mental health. Subsequently, even worse health impacts such as cervical cancer are emerging at the intersection of weak, non-targeted institutional policies, governance, and solutions promoted by private capital and the state, independently, in conjunction, or as a nexus. Agenda for action, we argue, necessitates moving beyond the intersectional analysis and adopting a justice framework. At the local level, this comprises an actor-oriented, agent-based framework of co-production of knowledge whereas at the global level, it necessitates a radical repoliticization agenda to reform the resilience governance. The former identifies synergies with existing policies and governance at multiple and often obscured scales, as well as instituting new policies that are temporally and spatially definitive. The latter challenges emerging forms of disaster capitalism that increasingly misappropriates social-

ecological governance whereby services and products are chosen by the vulnerable consensually and without coercion, revealing a hegemonic pattern in production of maladaptation, responsibility of which in turn is pushed into individual domains. Challenging dominant epistemologies and ontologies (Demaria et al. 2023), commitment to pursue social justice and de-emphasizing positivist methodologies (Mikulewicz et al. 2023) are key in this task, the architecture of which, we hope, will be provided by future research.

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[1] Sundarbans is cyclone capital of India: IMD report. Down to Earth 24 January 2022, https://www.downtoearth.org.in/news/natural-disasters/sundarbans-is-cyclone-capital-of-india-imd-report-81244
[2] A thin, long piece of cloth used the same way as a towel, but much lighter and thinner than a towel.
[3] Mid-day meal (MDM) is a wholesome, freshly-cooked lunch served to children in government and government-aided schools in India. On 28 November 2001, the Supreme Court of India passed a mandate stating, "We direct the State Governments/ Union Territories to implement the Mid-day Meal Scheme by providing every child in every Government and Government assisted Primary School with a prepared midday meal."
[4] An Indian city and the capital of the state of Tamil Nadu, located in the southern part of the country and a popular migration destination for unskilled laborers from the Sundarbans. About 1700 km from the region of study.
[5] Fines, confiscation of boats and fishing gear, seizure of boat license permit.
[6] Offering sexual favors.
[7] A diagnostic test for cervical cancer.
[8] National Rural Employment Guarantee Act 2005 (or, NREGA No 42, later renamed as the "Mahatma Gandhi National Rural Employment Guarantee Act"), is an Indian labor law and social security measure that aims to guarantee the "right to work." It aims to enhance livelihood security in rural areas by providing at least 100 days of wage employment in a financial year to every household whose adult members volunteer to do unskilled manual work.
[9] Called, literally, "Soil digging work."
[10] A premium agriculture university of the country.
[11] The word "solution" used for want of a better expression.

Author Contributions:

The first author developed the article including compilation, writing, and subsequent editing. The second author conducted a large part of the fieldwork and the research that produced the primary data for analysis.

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Data Availability:

The data/code that support the findings of this study are available on request from the corresponding author, [AG]. None of the data/code are publicly available because they contain information that could compromise the privacy of research participants. Ethical approval for this research study was granted by University of Heidelberg.

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APPENDIX 1: Pooled, coded and themed responses of the mothers, grandparents and children among the upper castes / wealthier / agricultural households

Macro-level Household Adaptation Strategy	Respondents	Responses					
		Experience/Observation about physical shifts	**Governance and Institutional Response**	**Micro-level (Everyday) Coping / Adaptation Strategies**	**Implication**	**Impacts on Physical health**	**Mental Health**
Outmigration (Predominantly male members but also couples and couples with male children)	Mothers, Grandparents	**<u>Disasters</u>** Increase in smaller and larger disasters including storms and cyclones, More frequent erosions	Only post disaster relief in major disasters, not for freequent disasters No instititutional resilience building	Selling cattle, milk, eggs, migration, to cover losses and damages	No milk, eggs for the children available earlier for free	General weakness in children, Lack of concentration, Night-blindness Fatigue in mothers and overall weakness	High level of fatigue and anxiety; depression; tension about finances, recovery of losses and damages;
				Collecting prawn seedling	Standing, walking and swimming long hours (6-8 hours) in chest-deep river water	Skin disease / Rashes, Watery light-red vaginal discharges, Abdominal pain, muscle pain Physical Stress	Depression, Anxiety, Trauma
				Buying mobile phones and data card to contact migrating members of the family	No resources / money to buy milk, eggs, meat, fish or vegetables Neglecting cooking Depending on packaged food, health drinks, fast food, junk food	Children becoming weaker and more fatigued (observed by grandparents but not mothers)	Irritability, Impatience, Short-Temper in children and mothers both
				Installing TV/dish antenna for entertainment and relieving stress, anxiety and tensions			
		<u>Slow onset climatic shifts</u> Salinity in soil making rice cultivation difficult Cash crops (pulses, watermelon, chillies) no longer growing	Nepotism in employment Guarantee Scheme failing to offer livelihood security equitably Ecotourism not helping	**<u>Economic</u>** Collecting prawn seedling Crab catching Forest dwelling Daily wage / manual labour **<u>Food habits</u>** Dependence on fast / junk food available locally to compensate for the fish, vegetables, pulses available locally earlier Buying expensive health drinks	Multiple days and very long hours starting from midnight Increased competition forcing them to more physical effort and high input costs Confiscation of boats by the forest department	Skin disease / Rashes, Watery light-red vaginal discharges, abdominal pain, muscle pain Injuries from Tiger/crocodile attacks Physical Stress	Extreme Stress and Anxiety Diminishing sexual desires and activities leading to domestic violence from husbands
		Unavailability of fish in shallow and brackish waters, creeks			No fish in the meals Replaced by junk / fast food and drinks Non-preference of home-cooked meals Increase in daily food expense	Lack of growth and energy to study, carry out household chores and daily activities	Distress in mothers for not being able to provide fish to the children
		Salinity in freshwater ponds killing fish					
	Children	School closure because of frequent disasters No mid-day meals	Problem of access to Integrated Child Development Services Centre or Anganwadi Centres Distance Timings Caste Disasters affecting operation and supplies Staff shortage	Shift towards chips, instant noodles, biscuits, ice creams, ice and cotton candy, sponge cakes, lentil-based fried food	Absence of the main meal of the day for many children Not willing to engage in physical activities / outdoor sports More interest in watching TV or playing games in the mobile	Lack of concentration/attention Physical weakness and lack of enthusiasm Various stomach ailments including diarrhoea and dysentery	Lazyness in children, long hours of sleep, tiredness, lack of enthusiasm, missing friends in school
		Absense of one or both parents and siblings	No institutional care available for the teens and sub-adults	Not willing to engage in physical activities / outdoor sports Little social interaction beyond family Spending most of the time watching TV or playing games in the mobile	Grandparents becoming main caregivers for children and teens Living in hostels those who can afford	Headache and nausea Weakness and lack of strength Forgetful Lack of concentration / attention	Agony, anxiety, loneliness and depression Sleepy Tiredness Sadness and unhappiness

APPENDIX 2: Pooled, coded and themed responses of the mothers, grandparents and children among the tribal / marginal / forest dwellers / fishing households

Respondents	Responses					
	Experience/Observation about physical environmental shifts	**Governance and Institutional Response**	**Micro-level (Everyday) Coping / Adaptation Strategies**	**Implications**	**Impact on Physical health**	**Impact on Mental Health**
Mothers, Grandparents	**Disasters** Increase in smaller and larger disasters including storms and cyclones, More frequent erosions	Only post disaster relief in major disasters, not for freequent disasters No instititutional resilience building	Manual labour in adjacent towns	Daily commute in harsh conditions with minimal food intake	Physical exhaustion and stress	High level of fatigue; depression; tension about finances
			Crab catching	Multiple days and very long hours starting from midnight Increased competition forcing them to more physical effort and high input costs	Injuries from tiger attacks Physical exhaustion and stress Menstrual health issues	High level of Anxiety for securing catch and tiger / crocodile attacks Fear of the unknown (Supernatural powers) Fear of pirates / poachers
			Buying mobile phones and data card for work contracts and for contacting family	Compromise on family food expenses for women in particular	Weaknesses and Fatigue	Irritability, Impatience, Short-Temper
			Child labour both as domestic help and industrial labour	Staying away from parental care Minimal food Absence of homemade food Not enjoying meals	Absence of motherly care and regular meals Inadequate amount of food offered by employers	Anxiety in mothers, Distress, anguish among teens
	Slow onset climatic shifts Increasing soil salinity making agriculture difficult Cash crops (pulses, watermelon, chillies) no longer growing **Growing scarcity of work in agricultural sector as daily wage labours**	Nepotism in employment Guarantee Scheme failing to offer livelihood security equitably Ecotourism not helping No livelihood and food security programme	Crab catching Forest dwelling Daily wage / manual labour in local brick kilns	Multiple days and very long hours starting from midnight Increased competition forcing them to more physical effort and high input costs	Injuries from tiger attacks Physical exhaustion and stress Menstrual health issues	Extreme Stress and Anxiety
	Unavailability of fish in shallow and brackish waters, creeks		Long hours and total duration of fishing trips Overdependence on rice and potato in daily meals	Higher risks High inputs costs No fish to eat in daily meals because of inability to buy fish	Physical strain from long fishing trips Physical weaknesses and poor vision for women and children	Distress in mothers for not being able to provide fish to the children
	Salinity in freshwater ponds killing fish		Increase in consumption of rice and potato based meals for being cheaper Market-based food	Non-preference of home-cooked meals Increase in daily food expense	Lack of growth and energy to study, carry out household chores and daily activities	Lazyness in children, long hours of sleep, tiredness, lack of enthusiasm
Children	School closures because of frequent disasters	No mid-day meal		Missing main, filling cooked meal of the day Not meeting friends at school	Not willing to engage in physical activities / outdoor sports More interest in watching TV or playing games in the mobile Headache and nausea	Sleepy Tiredness Sadness and unhappiness
	Poor school enrolement for children in the community				Dependant on hunting and gathering	High food insecurity and stress

APPENDIX 3: Pooled, coded and themed responses of the quack doctors (unlicensed medical/health services providers) and registered biomedicine doctors

Type of Health Experts	Observation	Impact Assessment	
		Women	Children
Quack doctors and paramedics Anganwadi Workers Managers of Shelter homes	Leafy green vegetable not easily available anymore, young mothers do not recognise them or take the trouble of finding them	General weakness, widespread aneamia	Meals only carbohydrate-based
	Absence of fish, milk, eggs in the daily diet		Weakening of the immune system Stunting Malnourishment
	High level of stress because of migration of husbands, livelihood insecurities, physically strenuous prawn seedling collection	High level of physical stress and anxiety Irritable, anxious, short-tempered	Anxiety, fear, uncertainty
	Early marriage for girls because of increasing climatic and disaster stress Childbirth in teenage physically and mentally stressful, making women vulnerable to anaemia and other diseases	Poor reproductive health and complications in gestation period	Complications in the neonatal stages
	Increased consumption of junk / packaged / fast food / health drinks to compensate imbalanced meals and as stress-buster	NA	Malnutrition, severe dysentery, stomach ailments
	Both parents migrating increasingly	Mothers are emotionally stressed for the guilt of not being able to care for their children left behind	Lack of care Absence of nutritious meals Depression, loneliness, anxiety
Registered Biomedical doctors (insert footnote)	Unavailability of fish and vegetables making diet carbohydrade heavy	Widespread anaemia Irritability Lack of patience / reasoning	Acute shortage of micronutrients which affect absoption of macro-nutrients Lack of concentration
	Pulses, grown abundant locally earlier, no longer available	Pulses provided necessary proteins along with eggs and milk Very high protein deficiency, particulalry Omega 3 Fatty Acids affecting absorption of nutrients from food	
	Increased intake of junk/ packaged/fast food/health drinks to compensate meals Also act as stress-buster	Anaemia Anxiety and depression	Malnutrition Stunting Wasting Anxiety and depression
	Increase in catching prawn seedlings for compensating livelihood insecurities	Sharp increase in cervical cancer and gynaecological ailments	NA
	Migrant husbands	Spread of sexually transmitted diseases including HIV	NA
	High level of pesticide in paddy and vegetables During regular inundations, pesticide laden water spill over to sweetwater ponds	Low food value and pesticide residue affecting general health and increasing susceptibility of diseases such as cancer Increase in diarhhoeal diseases and digestive ailments significantly Leading to further malnutrition Malnutrition leads to depression, irritability, anguish, weakening coping mechanisms Lack of concentration /attention	
	Washing utensils and clothes in saline ponds increasing diarrhoeal disorders		
	Deep tubewells, main source of drinking water, turning saline		
	Fruits like papaya and sapodilla (vital sources of micronutrients) not available	NA	Malnutrition and vitamin deficiency
	Watching TV or engaged in mobiles for coping with depression, stress and anxiety Affects cooking time and meal preparation	Headache, nausea, night-blindness Irritability, Lack of concentration	Malnutrition Lack of physical activities
	Migration of both parents Children not eating proper meals in absence of parents Children not sleeping well	Sense of guilt, sadness and tension for the children	High emotional stress Depression, Anxiety, Loneliness Malnourishment

APPENDIX 4: Pooled, coded and themed responses of agricultural and fisheries scientists along with farmers and fisherfolk

Categories	Observation	Analysis	Impact on local food	Physical and mental health Impact on women and children
Fisheries Scientist	Increase in Sea Surface Temperature	Commercially valuable fish stock shifting to cooler and deeper waters	Fish stock depleting near coast Quality of fish deteriorating / becoming poisonous Mangrove ecosystem and ecological cycle getting jeopardised	Malnutrition in Women and children for poor availability and access to food Severe emotional and psychological stress on women to provide healthy meals to the family Heavy metal in fish affects health of both children and adults Gynaecological diseases Livelihood insecurity High level of anxiety when husbands / men go for longer and riskier fishing expeditions
	Increasing pollution because of tourism	Increase in 'trash' fish (those which can tolerate high pollution levels) near the coasts and shallow rivers High levels of heavy metals in fish		
	Increased frequency of cyclone and disasters	Affecting spawning cycle and causing habitat loss		
	Widespread collection of prawn seedling by women	Kills large number of other fish species, partcilualry hatchlings of local varieties		
	Increase in salinity ingression into rivers	Killing the spawning sites of many varieties		
	Mechanised trawler fishing affect spawning grounds	Killing smaller and locally available fish by disturbing their nesting sites		
	Overfishing	Less fish available near the coast, many varieties disappearing altigether		
Fisherfolk	Little catch in shallow water or coasts	Going deeper in the sea with higher risks and increasing input costs		
	Increase in input costs (fuel, time and risks)	Price of fish increases while profit for fishers decrease		
	Large commercial trawlers affecting small fishers	Small fisherfolk gravely affected with livelihood insecurities		
	Loss of local varieties of small fish	Nothing to sell in the local markets		
Agricultural Scientists	Increased salinity in the soil	Pulses, certain vegetables, fruits do not grow locally anymore	Shortage of locally grown food – cereals, vegetables, pulses, fruits Contamination of drinking water Livelihood insecurity for small, subsistence farmers Agro-Biodiversity getting heavily jeopardised Unavailability of rice for six months a year which necessitates buying rice Creates additional stress on household finances Less buffer for household-level resilience Household level stress because of crop failure, decreasing yield	Liveihood insecurity leading to additional stress for women Buying rice from the market adds additional financial and emotional stress Diminishing local vegetables and fruits affecting the food basket with grave implication on nutrition High level of pesticide in vegetables such as okra and aburgine leading to ailments and malnutrition Absence of indigenous rice varieties and other vegetables with medicinal properties affecting immunity and health conditions
	Intense use of pesticide and chemical fertilisers	For compensating loss of production from the impacts of climate change.		
	Pesticides used on soil mixing with both river and pond water	Drinking water getting polluted, leafy vegetables grown around water bodies not growing anymore		
	Micro-organisms conducive for paddy production dying with high level of pesticides	Crop failure in rice has become frequent, traditional cultivation with ducks no longer possible		
	High-yielding varieties from green revolution have led to loss of indigenous, rice varieties	Local, saline resistant rice not available anymore, rice varieties with medicinal properties also lost		
	High-yielding varieties increasingly becoming less productive	Subsequent generations of the HYV failing for weaker generational progression and now need heavy chemical fertilisers		
Farmer	Irregular rain and seasonal shifts in cultivation	Affecting all kinds of crop including cereals, vegetables, pulses and fruits		
	Increase in temperature post rain event	Cultivation of watermelon, chillies cannot be grown anymore		
	Erosion reducing farmlands, yield	Increasingly shrinking landmass for farming		
	Everyday inundations and flooding destroys crop and increases salinity	Crop failure and subsequent livelihood insecurity along with food shortage as the majority of farming is subsistence		

APPENDIX 5: Data from ethnographic observations with different communities

Communities	Ethnographic Observations	Implication
Tribal Communities	Tribal communities eat different kinds of meat, particularly pork and snakes	Less protein deficiency within the community But more prone to worm infestation that causes malnutrition
	Poor access to processed and packaged food in and around tribal villages as these are located in remote areas	Less access of market areas and unavaialibility of processed and packaged food
	Mothers in particular and males in general migrate out less because of lack of capital and social network	Children receive better care from mothers
	(illegal) poaching and crab catching because of the proximity to the forests and coasts	Offers buffers to the daily meals and in nutrition
	Less attendance / enrolement in schools that deny mid-day meals to children	Often misses main meal of the day
	Most affected by disasters because of location of villages close to coasts and forests	Post disaster, schools become inaccessable for Children who inturn miss the mid-day meals Recovering from everyday disasters compromises food expenses
	Drinking water sources often polluted	Diarrhoeal diseases becoming acute
Upper caste / wealthier communities	Mothers in law blame young mothers of lazyness, not cooking and buying packaged food from markets	Less attraction for home-cooked meals, which are often absent
	Young mothers get highly influenced by TV advertisements about health drinks	Spend resources on aspirational packaged and processed food instead of nutritious food
	Different leafy vegetables, fruits, small fishes and snails in natural surroundings no longer recognised and collected by young mothers	Overt dependence on market-based food instead of natural, locally available raw materials
	Competition towards buying / procuring aspirational food for their wards among young mothers	No resources left to procure raw materials from the markets for home cooking
	Dish TV/DTH/ mobile services (gaming in particular), travel costs and non-food expenditure increasing with out-migration	Despite increase in incomes in many cases, neither the food expenditure is increasing nor it is spent on nutritious food
Quack doctors	Giving out differently coloured tablets and capsules in different combinations in small paper sachets These were 'cooling' medications, they said which meant psychiatric medicines	Many young women and girls are getting dependent on these psycotropic medications