



'Seeing with Empty Eyes': a systems approach to understand climate change and mental health in Bangladesh

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Abstract

Bangladesh's unique climate vulnerability is well-investigated but the mental health impacts of climate change remain relatively unexplored. Three databases were searched for English primary qualitative studies published between 2000 and 2020. Out of 1202 publications, 40 met the inclusion criteria. This systematic review applies a systems approach to further understand Bangladesh's 'climate-wellbeing' network. The literature indicates diverse factors linking environmental stress and mental ill-health including four key themes: (1) post-hazard mental health risks, (2) human (im)mobility, (3) social tension and conflict, and (4) livelihood loss and economic hardship. This systems analysis also revealed that people's mental wellbeing is strongly mediated by socio-economic status and gender. The article illustrates how multiple pathways may amplify stress, anxiety, violence, and psychological damage. Greater recognition of the 'climate-wellbeing' connections, and incorporation of mental health in current climate action and policy frameworks, will be an effective way to achieve a more sustainable future.

Keywords Bangladesh · Climate change · Disasters · Mental health · Sustainable wellbeing · Systems analysis

1 Introduction

The scale and intensity of human development over the past century has placed immense pressures on Earth's ecosystems. Human-induced climate change has brought about a new

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geological epoch, the Anthropocene, signalling an era of human dominance over Earth and an end to climatic stability (Crutzen, 2002). Global environmental changes and intensified hazards are part of the Anthropocene syndrome. The Intergovernmental Panel on Climate Change (IPCC) relates climate change to a rising frequency and severity of extreme weather events. Increased global warming amplifies a diverse array of environmental stress including rainfall, floods, cyclones, sea level rise, coastal erosion, salinity intrusion, drought, and land degradation (IPCC, 2018a, 2019a, 2019b). The IPCC defines an extreme weather event as one that is rare for a certain place or time of year, with an additional qualification that ‘by definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense’ (IPCC, 2018b). Climate change has been linked to a long line of direct and indirect risks to human health, including increases in infectious diseases (vector-borne, food-borne, and water-borne), non-communicable diseases (such as cardiovascular and cerebrovascular disease) and malnutrition (Haines et al. 2006; McMichael 2013). However, although the climate-health connections are increasingly well documented, the linkages between climate change and mental health remain less explored.

Mental wellbeing does not equate to the absence of psychiatric conditions; it includes accommodating states of mind such as happiness, fear, peace, and absence of stress (Butler et al. 2014). All of these are vulnerable to the impacts of climatic changes. For example, experiences of loss, grief, and trauma often occur due to sudden-onset weather events with inevitable impacts on people’s mental wellbeing (Berry 2018). Meanwhile, the term ‘solastalgia’ refers to the distress people may feel in response to slow-onset, negative changes in their local environments (Butler et al. 2014), and ‘ecological grief’ to the emotional suffering brought on by anticipated or experienced ecological losses. Ecological grief is forecasted to become more common in the Anthropocene with direct impacts on people’s mental health and wellbeing (Cunsolo and Ellis, 2018). On the climate policy arena, the UNFCCC and aligned scholars use the concept of ‘Non-economic Loss and Damage’ to describe such psychological damage (Barnett et al. 2016; Tschakert et al. 2019; Ayeb-Karlsson et al. 2020). Mental health impact relating to extreme heat is another research area in need of more investigations where reports indicate increased heat-related deaths in psychiatric patients, and spikes in mental health emergencies in times of high humidity and ambient temperature (Naughton et al. 2002; Hansen Alana et al. 2008; Vida et al. 2012; Ding et al. 2016).

Climate change is suggested to particularly undermine mental wellbeing in natural resource-dependent rural societies, due to, for example, agricultural damages and losses of livelihood and income security that translate into psychological stress and despair (Berry et al. 2008). A systems framework has been proposed to more effectively capture the interlinkages of the health pathways and causal relationships connecting climate change and mental health. To summarize the climate-wellbeing nexus, (1) climate change exposes people to trauma and directly damages mental health, (2) climate change poses indirect threats to mental health via effects on physical health, and (3) climatic changes erode economic and social wellbeing which undermines social and mental wellbeing (Berry et al. 2010).

As observed, climate exposure and effects are not distributed equally, with low-income settings being hit harder and bearing the greatest social, economic, and environmental burdens (Watts et al. 2019). Bangladesh is a unique country, with unique climate vulnerability, where people are facing multifaceted exposure to a wide variety of environmental stress (Ayeb-Karlsson et al. 2016). Its diverse ecology, its position in the Ganges-Brahmaputra-Delta, and its proximity to the ocean and subtropical monsoon provide for rich opportunities in agriculture, aquaculture, and trade, but these factors also present an exceptional constellation of

climate risks. These are divided into four ‘risk hotspots’: (1) a cyclone or storm surge area (in the southern coast), (2) a flood area (most regions), (3) a sea level rise and salinity intrusion region (in the southern coast), and (4) a drought and increased temperature risk area (in the northwest region) (Kibria and Haroon 2017).

Climatic stress and environmental shocks coalesce with rural-urban migration and poverty incidence, and may precipitate resource-related conflicts or social tension (Dasgupta et al. 2014; ECDS Cell 2017). People engaging in agriculture as a main source of income are especially vulnerable. Changes in rainfall, sea level rise, or soil salinization can, for example, result in crop loss (FAO 2018). Declining crop yields may provoke economic insecurity and food insecurity and damage traditional farming practices. Small-scale rice farmers, for example, may be forced to switch to ecologically and financially destructive shrimp farming that erodes local economies and exacerbates income inequality (Huq et al. 2015).

The broad impacts of climate change transcend to many areas of life, and inevitably may undermine physical health and mental wellbeing. Most climate change research in Bangladesh, however, focusses on agricultural and hydrological problems and even health in a traditional sense is relatively unexplored (Rahman et al. 2019). Recent primary studies have explored various aspects of climate-induced mental illness in Bangladesh and highlight it as a topic of importance. Cyclones inflict psychological damage, with affected populations experiencing post-traumatic stress, anxiety, depression, and sleep disorders (Tasdik Hasan et al. 2020). Cyclones have also been linked to increases in gender-based violence, sexual violence, and early marriage (Ahmed et al. 2019a and b; Rezwana and Pain 2020). In the hill tract region, psychological outcomes of climatic changes include depression, anxiety, suicide, and increased substance use (Kabir 2018). Women residing in disaster-prone areas are at higher risk of developing depression due to physical injuries and work-absenteeism post-cyclone (Mamun et al. 2019a and b). These patterns of damage occur in a context where mental ill-health already constitutes a significant public health burden, with a reported national prevalence of mental disorders from 6.5 to 31% in adults, and from 13.4 to 22.9% in children (Hossain et al. 2014). Research findings indicate that the mental health burden of climatic changes in Bangladesh (both currently and in the future) is likely to be significant, especially among vulnerable populations, and is an issue that deserves greater attention. A deeper understanding of the climate-wellbeing links will help identify key areas of concern that can inform future research and policy, while supporting greater recognition of mental health in global climate change policy.

2 Methods

The study includes English primary qualitative publications referring to mental or psychological aspects of climate change in Bangladesh within the PubMed and Web of Science databases, published in between the 1st of January 2000 and the 31st of May 2020 (see Table 1). PubMed was chosen for its strong coverage of health science and social science topics (including mental health) and Web of Science due to its widespread literature in life science and natural science that includes climate change issues. Besides the two databases, an additional literature search for grey literature was carried out in Google Scholar, screening the first 10 pages of results or the first 100 results to capture additional academic or grey literature not available or retrieved from the other two databases. Articles were included that referred to climate change and/or subsequent environmental stressors and their mental health impacts in

Table 1 Overview of publications meeting inclusion criteria

Authors and year of publication	Qualitative data collection method/s	Study location (district)	Number of informants	Informant's age	Informant's gender	Environmental stressors experienced/ recorded	Impacts on life	Impacts on mental health and wellbeing
1 Ahmed et al. (2019a and b)	Interviews, questionnaire	Jamalganj Upazila (Sunamganj), Brahmanbaria Sadar Upazila (Brahmanbaria)	120	34 to 67	Mixed	Floods Cyclones	Food insecurity Livelihood insecurity Economic insecurity Death Injury Loss of property, crops Early marriage School dropout Widowing Evacuation to cyclone shelters	Sexual violence Harassment Fear Embarrassment
2 Akhter et al. (2015)	Interviews, focus group discussions, short scripts, and drawing	Bhola, Shaikira, Kurrigam	45	Unclear	Mixed	Floods Cyclones Water logging	Food insecurity Economic insecurity Livelihood insecurity Sanitation difficulties Disease spread Malnutrition School dropout Early marriage ; security of daughters	Fear, panic Distress Trauma Profound melancholy Post-traumatic stress Nightmares Sexual harassment; abuse Helplessness
3 Alam and Rahman (2014)	Focus groups, interviews, questionnaire, case studies	Pathaighata Upazila (Barguna)	125	Unclear	Women	Cyclones Floods Salinification Drought Coastal erosion	Food insecurity Loss of family members Loss of assets Evacuation to cyclone shelters	Fear Harassment Physical abuse Unwanted staming Uncertainty Domestic violence Loss of family unity
4 Alston et al. (2014)	Interview, focus groups	Gaibandha, Satkhira, Barguna	Unclear	Unknown	MIXED	Cyclones Floods Riverbank erosion Drought	Loans Alternative livelihoods School dropout Child labour	Abuse of young married girls: used as servants, physical abuse Dowry-related violence

Table 1 (continued)

Authors and year of publication	Qualitative data collection method/s	Study location (district)	Number of informants	Informant's age	Informant's gender	Environmental stressors experienced/recorded	Impacts on life	Impacts on mental health and wellbeing
5 Ayeb-Karlsson et al. (2016)	Interviews	Dalbanga South (Barguna), Mazer Char (Pirozpur), Gabtola (Bagherhat), Singpur (Kishoreganj), Babupur, Jamalpur (Naogaon), Bhola Slum (Dhaka)	28	21 to 80	Mixed	Cyclones Floods Riverbank erosion Drought	Child marriage Economic insecurity Food insecurity Food insecurity Land degradation Livelihood instability Loss of livestock, crops Death of family members Seasonal migration Water insecurity Alternative livelihoods Forced displacement Loss of family members	Resource-related conflicts, violence Loss of happiness Loss of pride
6 Ayeb-Karlsson et al. (2020)	Q methodology, interviews	Bhola Slum (Dhaka)	62	16 to 66	Mixed	Riverbank erosion Loss of land, home	Displacement Migration Economic insecurity Dangerous living environment (slum) Immobility	Fear/anxiety about eviction Depression Disappointment Meaning/lessness Emotional emptiness Feeling trapped Loss of identity Lost sense of belonging Loss of honour
7 Azad et al. (2013)	Interviews, focus groups	Sirajgang Sadar, Kazipur, Ullahpara, Chauhali (Sirajganj)	185	Unknown	Women	Floods	Food insecurity Injury Poor physical health Livelihood insecurity Social disruption Increased crime Water insecurity Damage to agriculture Displacement Eviction threats Resource-related conflicts	Harassment: mental, physical, sexual Domestic violence: physical, mental Domestic tension Stress

Table 1 (continued)

Authors and year of publication	Qualitative data collection method/s	Study location (district)	Number of informants	Informant's age	Informant's gender	Environmental stressors experienced/recorded	Impacts on life	Impacts on mental health and wellbeing
8 Azad and Khan (2015)	Interviews, focus groups	Paikgacha, Koyra (Khulna), Kaligonj (Satkhira)	190	15 to > 75	Mixed	Cyclones Water logging Salinification	Increased domestic work burden Damage to agriculture, crops, livestock Loss of land Livelihood insecurity Unemployment Food insecurity Increased physical health conditions Alternative livelihoods Loans Corruption, crime, theft Trafficking, child labour Drug addiction Male out-migration Widowing Destruction of property Migration to slums Eviction from new settlements	Domestic violence—male to female (sexual, emotional) Dowry-related violence Child abuse Sexual exploitation (women) Loss of social capital Stress
9 Begum (2017)	Literature review (working paper)	n/a	n/a	n/a	n/a	Cyclone Salinification Floods River bank erosion	Destruction of property Migration to slums Eviction from new settlements	Domestic violence Sexual violence Traumatic birth complications (premature abortion, postpartum haemorrhage)
10 Biswas et al. (2010a and b)	Household survey, interviews	Raiganj Upazila (Sirajganj)	638	15 to 49	Women	Floods	Damage to home Dangerous home environment Injury Increased domestic work burden (women) Economic insecurity Food insecurity Loan stress Displacement Food insecurity	Domestic tension Domestic violence by husband (emotional, physical, sustenance, sexual) Violence against children by both parents (emotional, physical, sustenance)
11 Biswas et al. (2015)	Questionnaire, interviews, focus groups	Kalapara Upazila (Patuakhali)	100	16 to 30	Women	Floods Cyclones	Displacement Food insecurity	Harassment

Table 1 (continued)

Authors and year of publication	Qualitative data collection method/s	Study location (district)	Number of informants	Informant's age	Informant's gender	Environmental stressors experienced/recorded	Impacts on life	Impacts on mental health and wellbeing
12 Choudhury et al. (2006)	Survey	Tangile, Jamalpur	150	18 to > 50	Mixed	River erosion Salinification Convective storm	Water insecurity Economic insecurity Insecurity in cyclone shelters Food intake restriction Lack of health provision Increased daily task burden (women) Family expectations Livelihood insecurity	Violence; physical, sexual, domestic Shame Trauma Depression Sadness Guilt PTSD
13 Deb and Haque (2011)	Interviews, focus groups, direct observation, participation	Volarkandi (Moulavibazar), Thakurtala (Cox's Bazar)	Unclear	Unknown	Mixed	Cyclones Floods Saline intrusion	Death of family members Cannot grow crops Food scarcity; reduced food intake Water insecurity Livelihood stress Dangerous livelihoods Loss of assets, property Economic insecurity Cyclone shelters; theft and overcrowding	Adjustment disorder Suffering Stress Psychological shock Misery Depleted psychological reserve
14 Deb and Haque (2017)	Interviews, case studies, focus groups, direct observation, and participation	Thakurtala village (Cox's Bazar), Volarkandi village (Moulavibazar)	Unknown	Unknown	Mixed	Cyclones Floods Changing patterns of seasons Extreme rainfall Increasing temperature	Poor physical health Declining fish catch Crop failure Food insecurity Livelihood instability Evacuation of the vulnerable Extended workloads (women) Livelihood switch	Depression PTSD Family tension Self-exploitation Social isolation Helplessness Frustration

Table 1 (continued)

Authors and year of publication	Qualitative data collection method/s	Study location (district)	Number of informants	Informant's age	Informant's gender	Environmental stressors experienced/recorded	Impacts on life	Impacts on mental health and wellbeing
15 Ferdous and Mallick (2019)	Focus groups, interviews, case studies	Jharshingershar (Nilphamari), Panjorvanga (Rangpur), Char Dhubni, Dalhagram (Lalmonirhat)	Unknown	Unknown	Mixed	Floods River erosion Drought Storms Erratic rainfall Waterlogging Heat stress	Malnutrition Debt stress, land-grabbing Damage to agriculture, homes Food insecurity Water insecurity Child marriage School dropout Economic insecurity Problems coping with household responsibilities (women) Livelihood instability Poor sanitation	Stress
16 Gruebner et al. (2011a and b)	Interviews	Dhaka	1938	15 to > 65	Mixed	Floods		Depression
17 Habiba et al. (2013)	Literature review (book chapter)	n/a	n/a	n/a	n/a	Salinification Sea level rise	Damage to agriculture, aquaculture Water insecurity Poor physical health Increased domestic workload (women)—especially water collection Resource-related conflicts	Exhaustion Domestic tension Domestic violence Harassment Feeling threatened
18 Islam (2010)	Interviews, observation	Shannagar (Satkhira), Sarankhola (Bagherhat)	120	15 to 65	Women	Salinification Cyclones Floods Extreme rainfall Tidal surge River erosion	Increased domestic workload—water collection Insecurity in cyclone shelters Adverse reproductive outcomes	Harassment; physical, mental, Lack of privacy Indignity Traumatic injury

Table 1 (continued)

Authors and year of publication	Qualitative data collection method/s	Study location (district)	Number of informants	Informant's age	Informant's gender	Environmental stressors experienced/recorded	Impacts on life	Impacts on mental health and wellbeing
19 Islam and Rashid (2011)	Social survey	Chapai Nawabganj, Rajshahi	Unknown	Unknown	Unknown	Riverbank erosion	Economic insecurity Malnutrition Theft Loss of land, home, property, crops Homelessness Displacement Livelihood insecurity Economic insecurity Theft Harassment Lost community bonds Conflict in receiving community	Fear Sexual and domestic violence Anger Flashbacks Helplessness Guilt Suicidal ideation
20 Kabir (2014)	Questionnaire survey, focus groups (PhD thesis)	Koyra Upazila (Khulna), Amati Upazila (Barguna)	973	< 30 to > 50	Mixed	Cyclones Waterlogging	Water insecurity Loan pressure Economic insecurity Alternative, dangerous livelihoods Loss of family Increased household responsibilities (women)	Trauma Mental pressure Shock Anxiety Fear Harassment and abuse collecting relief Traumatic birth complications
21 Kabir et al. (2014)	Focus group interviews	Amati Upazila (Barguna), Koyra Upazila (Khulna)	Unknown	Unknown	Unknown	Cyclones Storms Floods Salinification Sea level rise Temperature rise Erratic rainfall patterns	Damage to agriculture and aquaculture Livelihood insecurity Economic insecurity Destruction of property Loss of family members Food insecurity Water insecurity Increased household burden (women)	Mental pressure Worry Uncertainty Misery Sadness Trauma Traumatic birth complications

Table 1 (continued)

Authors and year of publication	Qualitative data collection method/s	Study location (district)	Number of informants	Informant's age	Informant's gender	Environmental stressors experienced/recorded	Impacts on life	Impacts on mental health and wellbeing
22 Kabir et al. (2016)	Focus groups	Amali upazila (Barguna), Koya (Khulna)	Unlear	Unknown	Mixed	Salinification Cyclones	Loan stress School dropout; child labour Migration to cities Health problems Exposure to devastation Injury Malnutrition Damage to agriculture, aquaculture Loss of property, possessions Witnessing devastation Food insecurity Livelihood insecurity Loan/debt stress Alternative (dangerous) livelihoods Malnutrition Pregnancy/birth complications aquaculture Livelihood instability; unemployment Loss of family members Health problems post-disaster Disrupted access to work Increased drug and alcohol use Boredom, lack of purpose	Fear, uncertainty Misery Devastation Psychological trauma Shock Harassment Anxiety
23 Kabir and Khan (2017)	Questionnaire survey	Amali Upazila (Barguna), Koya Upazila (Khulna)	Approx. 1000	< 30 to > 50	Mixed	Cyclones	Damage to agriculture and aquaculture Livelihood instability; unemployment Health problems post-disaster Disrupted access to work Increased drug and alcohol use Boredom, lack of purpose	Mental disturbance
24 Kabir (2018)	Interviews	Chittagong, Cox's Bazar, Rangamati, Bandarban, Khagrachhari	125	10 to > 70	Mixed	Seasonal temperature changes Cyclones	Increased loss of self-worth Suicidal ideation Amplification of previous trauma Distress	
25			24	> 60	Mixed	Cyclones		

Table 1 (continued)

Authors and year of publication	Qualitative data collection method/s	Study location (district)	Number of informants	Informant's age	Informant's gender	Environmental stressors experienced/recorded	Impacts on life	Impacts on mental health and wellbeing
Malak et al. (2020)	Interviews, focus groups, oral histories	Garbura, Lehubunia, Durnuria (Satkhira)					Damage to housing, agriculture Livelihood instability Economic insecurity Water insecurity Physical injury Death Loss of social capital	Mental illness Grief
26 Mamun et al. (2019a and b)	Interviews, structured questionnaire	Dalbangha village (Barguna)	111	≥ 18	Women	Cyclone	Injury Absence from work Financial loss Death of family members Increased domestic workload (women) Widowhood Danger during cyclone Destruction of property Death Evacuation to cyclone shelters Lack of privacy Gender-specific vulnerability	Depression Feelings of failure
27 Nahar et al. (2014a and b)	Literature review	n/a	n/a	n/a	n/a	Floods Cyclones Erratic rainfall Sea level rise Drought		PTSD Depression Anxiety Somatoform disorder Guilt and feelings of failure not fulfilling duties Sexual harassment
28 Rahman (2013a and b)	Household surveys, interviews, focus groups	Patharghata Upazila (Barguna)	125	< 30 to > 60	Women	Cyclones	Insufficient healthcare provision Insecurity in cyclone shelters Increased material and emotional workloads Theft Water insecurity Unequal relief distribution	Sexual harassment Exposure to violence Domestic violence loss

Table 1 (continued)

Authors and year of publication	Qualitative data collection method/s	Study location (district)	Number of informants	Informant's age	Informant's gender	Environmental stressors experienced/recorded	Impacts on life	Impacts on mental health and wellbeing
29 Rahman (2013a and b)	Interviews	Bauphal (Patuakhali), Amatali, Tallali (Barguna), Bhola sadar (Bhola), Sirajong sadar (Sirajong)	Unknown	Unclear	Women		Damage to agriculture, housing Livelihood insecurity Food insecurity Malnutrition Widowing Economic insecurity Increased domestic workload Deteriorating work conditions Restriction of food intake Reproductive/sexual health problems	Post-disaster stress Domestic violence (sexual, emotional) Harassment in cyclone shelters—rape, abduction Shame
30 Rahman et al. (2019)	Literature review	n/a	n/a	n/a	n/a	Floods Cyclones Riverbank erosion	Insecurity in cyclone shelters Child marriage School dropout Trafficking	Sexual violence Domestic violence Harassment
31 Rashid M (2013a and b)	Direct observation, focus groups, interviews, questionnaires	Modhyam Char Marama (Chittagong), Shebagram (Lakshmipur), East Modhyabagya (Noakhali), Mombipara (Patuakhali), Kaliar Khal (Barguna)	1489	Unknown	Unknown	Cyclones Floods Water logging Salinification Erratic rainfall	Loss of life, property Debt stress Damage to agriculture, aquaculture Alternative, dangerous livelihoods Landlessness Seasonal and permanent migration	Torture/abuse in urban labour environment Harassment (women) Extreme concern Aimlessness Loss of family ties
32 Rashid S (2000 and b)	Interviews	Shahidietek, Bailhola, Katsahurbeti, Shibir Masjid, Mothertek slums (Dhaka)	32	Unknown	Mixed	Floods	Child labour Disruption to basic services Damage/loss of home, property Snake and rat bites	Fear Shame, indignity Harassment (women) Domestic tension

Table 1 (continued)

Authors and year of publication	Qualitative data collection method/s	Study location (district)	Number of informants	Informant's age	Informant's gender	Environmental stressors experienced/recorded	Impacts on life	Impacts on mental health and wellbeing
33 Rashid and Michand (2000 and b)	Interviews	Manikganj, Dhaka	9	15 to 19	Women	Floods	Injury Death Appalling living conditions Theft Water insecurity Poor physical health Unemployment, livelihood insecurity Loans, debt stress Displacement Evacuation to relief camps Submersion of houses Living in exposed conditions Strong taboos around menstruation Confinement within houses Loitering men Economic insecurity Fear about failure to pay dowry	Domestic violence (physical, verbal) Distress, anxiety Broken community networks Shame Fear Harassment Rape, murder Anxiety Tension Violence in shelters Fear of abandonment
34 Rezwana and Pain (2020)	Interviews, group discussion, observation	Barguna	37	Unknown	Mixed	Cyclone	Death Injury Insecurity/danger in cyclone shelters Refusal to use shelters Damaged homes Unemployment Economic insecurity	Sexual assault Physical violence Sexual violence Eye-teasing Fear Helplessness Decreased confidence PTSD Harassment
35 Sams (2019)	Interviews, focus groups	Gollamari, Baghmara, Mujgauni,	65	21 to 60	Mixed	Riverbank erosion Floods	Damage to agriculture, land, homes	Dowry-related violence Loss of dignity, honour, status

Table 1 (continued)

Authors and year of publication	Qualitative data collection method/s	Study location (district)	Number of informants	Informant's age	Informant's gender	Environmental stressors experienced/recorded	Impacts on life	Impacts on mental health and wellbeing
		Labanchhara, Nounbazar (Khulna)				Cyclones Sea level rise Salinification Water logging	Economic insecurity Loans, selling of assets Migration Displacement Cyclone shelters Poor physical health Alternative livelihoods Poor slum conditions: lack of sanitation, waste, health facilities	Violence, conflict with receiving community Domestic violence
36 Shahriar and Shepherd (2019)	Interviews	Bogra	583	18 to 45	Women	Floods River bank erosion Cyclone	Lack of privacy Heightened impact of domestic violence on women's entrepreneurship	Amplified psychological impact of domestic violence
37 Sugden (2014)	Literature review (working paper)	n/a	n/a	n/a	n/a	Floods Riverbank erosion Salinification Erratic rainfall Cyclones	Damage to agriculture, aquaculture Loss of land Food insecurity Increased domestic workloads (women) Water insecurity	Anxiety Sleep disturbance Desperation Helplessness Loss of family ties Loss of dignity Harassment Domestic violence (verbal, physical)
38 Tasdik Hasan et al. (2020)	Interviews	Koyra Upazila (Khulna)	20	Mixed	Mixed	Cyclones	Economic insecurity Migration to cities Poor cyclone shelter conditions Malnutrition Prostitution, (child) trafficking School dropout Debt stress Loss of family members Exposure to devastation	Acute stress Depression

Table 1 (continued)

Authors and year of publication	Qualitative data collection method/s	Study location (district)	Number of informants	Informant's age	Informant's gender	Environment's stressors experienced/recorded	Impacts on life	Impacts on mental health and wellbeing
39 Yasmin and Ahmed (2013)	Direct observation, interviews, focus groups	Bandartila (Noakhali), Patgram (Manikganj)	Unknown	Mean age= 48.96 (s.d. 10.26)	Mixed	Cyclones Floods Riverbank erosion	Economic insecurity Loans Loss of precious possessions to pay interest on loans Land bandits Damage to homes Migration Alternative livelihood Early marriage	Sadness, grief Helplessness Psychotic breakdown Frustration Guilt Sleep disorder PTSD Anxiety, fear, panic Self-harm and suicidal ideation Domestic violence Sexual violence, harassment Damaged cognitive development Violent conflict over land Stress PTSD Domestic violence Mental instability Hindered ability to cope with recurring natural events
40 Yasmin et al. (2013)	Interviews, focus groups	Nijhumdwip (Noakhali), Patgram (Manikganj)	Unknown	Unknown	Mixed	Cyclones Floods Waterlogging	Loans Economic insecurity Selling of land, livestock, belongings Selling cheap labour in advance Early marriage Alternative livelihoods	Stress Domestic violence PTSD Decreased coping ability

the context of Bangladesh. As well as specific psychiatric conditions such as depression and post-traumatic stress, the search terms aim to include proximal determinants of mental health such as trauma or violence. This approach was necessary in order to capture the diverse ways in which climate change can exert psychological damage. Regarding environmental stress, the search terms aim to cover a range of acute hazards (such as cyclones, extreme rainfall, and flooding) and slow-onset hazards (such as riverbank erosion, salinification, and drought) which all are happening more often and more intensely as a result of climate change. Texts were excluded that did not relate to environmental stressors, did not relate explicitly to mental wellbeing (or its proximal determinants), or that were based outside of Bangladesh. One thousand two hundred two publications in total were identified through the literature searches, of which 40 met the inclusion criteria (see Fig. 1).

The systematic review investigates acute and protracted environmental changes, stress, and shocks (where hazards relate to climate change through their increasing frequency and intensity). Alongside sudden-onset, slow-onset events such as saltwater intrusion and erosion were included. The latter, although a natural process, is acknowledged to be influenced by sea level rise or precipitation patterns such as increased rainfall (attributable to climate change) (Wong et al. 2014). Meanwhile, mental health is conceptualized as a broader state of wellbeing, as environmental hazards exert psychological stress in diverse ways (see Table 2). Therefore, publications were retained in the screening process which may not have overtly mentioned mental health, but discussed important proximal determinants of mental ill-health, such as stress, violence, trauma, and abuse. The study selection approach is reflected in the search terms and inclusion and exclusion criteria (see [Supplementary Table S3](#)).

Thematic analysis was used to decipher relevant themes and subthemes from the reviewed literature, and to build a system map for the mental health effects of climate change in Bangladesh (see Fig. 2). This systems approach supported linking the factors that play key roles in mediating the relationship between the environment and mental health risk in Bangladesh. A systems analysis aims to understand the structure of systems as a whole while identifying key concepts within systems and the connections between them. Systems thinking

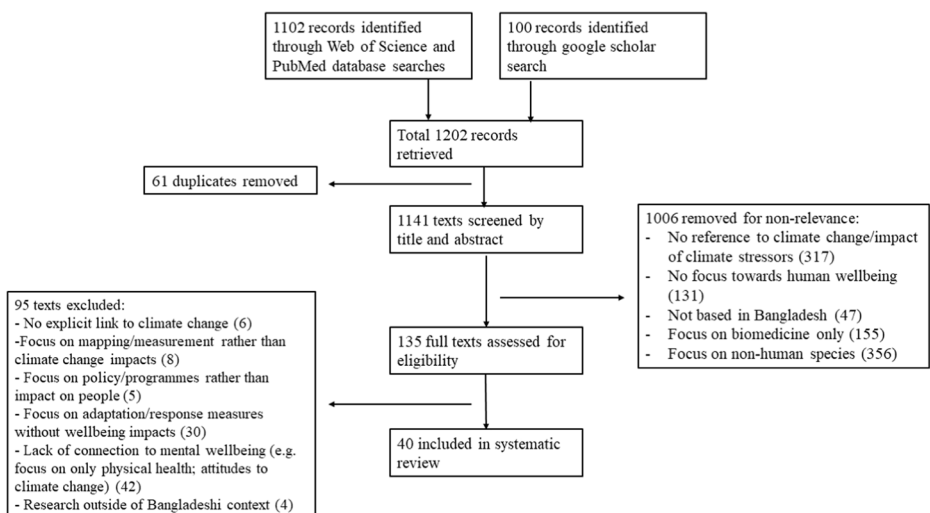


Fig. 1 Study selection

Table 2 The identified key thematic areas from the selected literature, organized by themes and subthemes

3.1 Post-hazard mental health risks	3.1.1 Immediate post-traumatic stress and depression
	3.1.2 Longer term development and wellbeing interruption
3.2 Human (im)mobility	3.2.1 Migration and immobility
	3.2.2 Displacement and evacuation
3.3 Social tension and conflict	3.3.1 Child abuse and injury
	3.3.2 Gender roles and domestic tension
3.4 Livelihood loss and economic hardship	3.4.1 Declining productivity, poverty, and unemployment
	3.4.2 Child marriage and dowry
	3.4.3 Loan pressures
	3.4.4 Alternative livelihoods

can be useful to interpret the network of information that relates climate change and mental health while maintaining its complex interactions. A ‘climate-wellbeing’ system can be depicted as a series of causal linkages such as in the causal process diagram presented on drought and mental health (Berry et al. 2018). Extreme weather events may cause widespread pressures on resources and society, which lead to strained social functioning and deteriorations in personal and emotional capacity, which in turn may exacerbate mental ill-health. Thus, a larger constellation of factors (with connections and reciprocities between them) can be linked to mental health risks.

3 Results

The literature covers a broad range of climate-induced factors that interact to produce different risks to mental wellbeing in Bangladesh. These complex climate-wellbeing pathways depict the diverse ways in which climatic stress links to people’s mental health. The results identified complex relationships where four main themes emerged. The domains undermine mental wellbeing both separately and interactively. The links between each of these themes and wellbeing risk are strongly mediated by additional vulnerabilities (especially gender and socio-economic insecurity), which produce a heterogeneous burden of mental health risk across Bangladesh’s society. The following result section is structured around these four themes.

3.1 Post-hazard mental health risks

Natural hazards may damage people’s wellbeing both in the short term and in the long term. Mental ill-health can manifest overtly as mental disorders, but frequently, the interrupted wellbeing is via a variety of stressors placed on individuals due to the hazards which predispose, contribute, or cause symptoms of mental illness.

3.1.1 Immediate post-traumatic stress and depression

Environmental shocks cause widespread distress to vulnerable individuals and families. Acutely, experiencing widespread destruction, and losses of life and loved ones, is traumatic in itself (Akhter et al. 2015; Kabir 2014; Kabir and Khan 2017; Tasdik Hasan et al. 2020). The devastation of losing homes, agricultural land, and livestock results in immense pressure, stress, and anxiety (Kabir et al. 2014), while flashbacks and fear of repeated disasters are

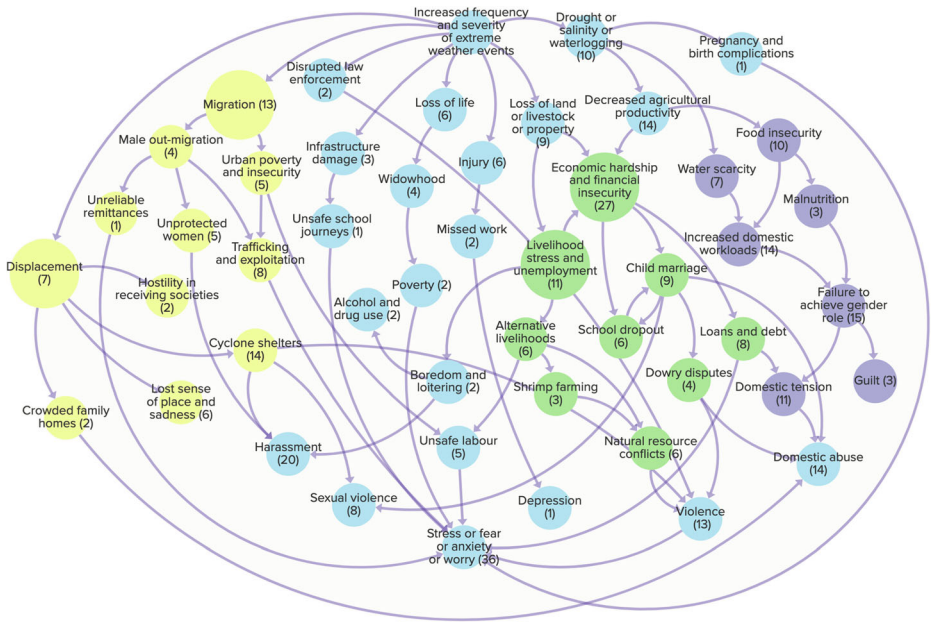


Fig. 2 A systems diagram outlining the mental health effects of climatic changes in Bangladesh. Illustration of the linkages between climatic changes and mental wellbeing in Bangladesh. Key thematic areas are grouped by colour, while red asterisks highlight factors where gender vulnerability plays an important role in mediating risk to wellbeing. The numbers in brackets indicate the amount of publications from the systematic review that describe each and every factor (authors’ own creation)

common psychological reactions which align with symptoms of PTSD (Choudhury et al. 2006; Islam and Rashid 2011; Akhter et al. 2015). For example, mothers in waterlogged areas sometimes live in constant fear of having their children suddenly drown (Kabir 2014), or see visions of their lost children (Akhter et al. 2015). The sounds of cyclone alarms, sirens, thunder, lightning, and loud horns can incite panic and anxiety in cyclone survivors (Tasdik Hasan et al. 2020).

Natural hazards can amplify previous traumas by compounding other personal psychological health issues (Kabir 2018). Depression is a common outcome where mass destruction and deprivation cause a loss of hope for the future and social isolation (Akhter et al. 2015), which increases the risk of depression (Choudhury et al. 2006). The inability to work due to injuries can also contribute to depression. For example, physical injury sustained by young Bangladeshi women in cyclone Mora caused them to miss work, which increased their chances of being depressed. Younger women are more likely to develop depression disorders from absenteeism (Mamun et al. 2019b). The helplessness and insecurity felt after cyclones also lead to self-harm, suicidal ideation, and suicide attempts (Tasdik Hasan et al. 2020). Older people experience greater delays in accessing healthcare for injuries sustained in cyclones due to their immobility, which causes them mental distress (Malak et al. 2020). Natural hazards have particularly severe consequences for women as widowhood poses serious threats of poverty, insecurity, and family tensions (Nahar et al. 2014b; Deb and Haque 2017; Ahmed et al. 2019a and b; Tasdik Hasan et al. 2020). Poverty in itself is a source of mental trauma (Kabir et al. 2014).

3.1.2 Longer term development and wellbeing interruption

Environmental shocks also cause damage to infrastructure that undermines wellbeing in the long term. Disruption to law enforcement services during floods, for example, increases the risk of violence in families (Biswas et al. 2010a and b), while corruption, breakdown of social capital, and social disorder post-disasters cause increased crime rates (Azad and Khan 2015). Damaged roads and disrupted transport systems result in unsafe school journeys by banana rafts, where dangers of drowning and snake bites incite fear and panic in children (Akhter et al. 2015). Meanwhile, post-cyclone school closures deprive children (often having witnessed mass destruction) of protective factors such as structural activities and means to work through and process their feelings (Akhter et al. 2015). The fear and distress held by children lead to changed patterns of conversation and play, shaped by their experiences of death and destruction (such as playing ‘grave-grave’ or ‘burial-burial’). The trauma occurs in crucial windows of cognitive development, leading to long-term problems with cognition and personality (Tasdik Hasan et al. 2020).

3.2 Human (im)mobility

Widespread disruption wrought by acute and protracted climatic stress is a strong driving force of human mobility in Bangladesh. There are diverse mental health risks related both to migration (seasonal, temporary, or permanent resettlements for improved livelihood, living conditions or safety, with a supposed element of choice) and displacement (forced relocation due to danger, destruction, or political pressure).

3.2.1 Migration and immobility

A common climate change adaptation pattern is the movement from rural areas to urban centres. People often tend to rural-urban migration with the hope of finding employment in urban labour markets. Migrants often settle in slum or informal settlements, where they might earn more money. The living environment, however, can be worse than in their villages due to reduction and losses in health, safety, education, and food security (Ayeb-Karlsson et al. 2016, 2020). People also struggle adapting to the new conditions, especially when lacking social ties to their places of origin (Rashid 2013; Sugden 2014) or when in constant fear of losing their rights and place of shelter (Rashid 2000 and b; Ayeb-Karlsson et al. 2020). Urban deprivation instils feelings of indignity and shame, while status losses erode mental strength (Sugden 2014; Sams 2019; Ayeb-Karlsson et al. 2020). The urban slums’ exposure to flooding can be a further detriment to wellbeing (Gruebner et al. 2011a and b). Once living in urban slums, the inability to leave due to lost land, poor health, or financial constraints creates a feeling of being ‘trapped’, putting further strain on wellbeing (Ayeb-Karlsson et al. 2020). Furthermore, the need for work leads people into exploitative and unsafe working environments in cities. Migrants from rural areas with limited skills sometimes enter dangerous jobs unaware of the risks and suffer fatal accidents, while women and children in particular suffer physical and mental abuse in the urban workplaces (often within the garment industry) (Rashid 2013; Ayeb-Karlsson et al. 2020). Rural-urban migration also enables trafficking, whereby girls with no legal or psychological support, who may be orphaned by climate-related disasters, can be lured into prostitution as well as domestic and factory work (Rezwana and Pain 2020). Alongside the psychological toll of

these jobs, child workers often do not return to school (Sugden 2014), depriving them of protective educational and social factors.

Migration also creates problems for those left behind. Male out-migration from villages places additional stress on women, who may not be permitted to take decisions about finances without instructions from men, and can become indebted while trying to maintain adequate food and clothing for their families (Ferdous and Mallick 2019). Women forced to borrow money at high interest rates are pulled into vicious debt cycles, with female-headed households facing a greater risk of poverty (Sugden 2014). Remittances from men in the cities are often unreliable, adding to women's money management stress (Rashid 2013). Women are pushed to work outside the house with their men absent, where they tend to experience physical, verbal, and sexual harassment by their employers and co-workers (Azad et al. 2013; Azad and Khan 2015). Climate-induced male out-migration can also increase the risk of gender-based violence as women are left unprotected from abusers (Alam and Rahman 2014; Akhter et al. 2015; Rezwana and Pain 2020) and sexual exploitation whereby women are forced to use sex as a means of income (Azad and Khan 2015).

3.2.2 Displacement and evacuation

Extreme weather events force people out of their homes and social networks into unfamiliar and hostile surroundings, presenting a multitude of mental health risks. Displacement is an emotional ordeal. Internally displaced people (IDP) lose not only their land and homes but also their sense of place and belonging (Islam and Rashid 2011; Rashid 2013; Azad and Khan 2015; Ayeb-Karlsson et al. 2020; Rezwana and Pain 2020), while protective factors such as social bonds and networks may also be lost (Rashid 2000 and b). IDPs are subject to verbal abuse, theft, and eviction threats in receiving societies, where conflicts and violence can arise over land access, ownership (Ayeb-Karlsson et al. 2016), and vital resources such as water (Azad et al. 2013). Fear, flashbacks, and emotional shocks are common experiences in displaced people, as well as low self-esteem, sleep disturbance, and feelings of guilt in heads of family for compelling injured and disabled family members to move (Islam and Rashid 2011).

One important form of temporary displacement experienced by people in coastal Bangladesh is evacuation to cyclone shelters, where conditions can be particularly problematic for wellbeing. This is particularly felt by women, whom lack personal space, privacy, separate toilets, and menstrual facilities. The conditions may cause intense shame and mental strain—a risk that is compounded by strong social taboos around menstruation and the female body. In these overcrowded spaces, women suffer theft; harassment; rape; and physical, sexual, and emotional violence (Islam 2010; Rahman 2013a and b; Alam and Rahman 2014; Sugden 2014 Biswas et al. 2015; Ahmed et al. 2019a and b; Rahman et al. 2019). The fear of harassment in shelter toilets prompts women to eat less and avoid breastfeeding or using the toilets at all (Biswas et al. 2015; Kabir et al. 2016), while poor sanitation and menstrual management cause gynaecological problems and infections (Rashid and Michaud 2000 and b; Azad et al. 2013). In the long term, women can refuse to use cyclone shelters due to these traumatic experiences, increasing their vulnerability (Rezwana and Pain 2020). Problems of harassment and abuse also arise en route to shelters and in queues for relief supplies (Azad et al. 2013; Kabir 2014; Nahar et al. 2014b; Sugden 2014; Kabir et al. 2016; Rezwana and Pain 2020). 'Ransom marriages' have been described, whereby a woman is only given relief if she agrees to marry the relief distributor, as have cases of men pretending to be volunteers after cyclones as an opportunity to abuse and harass women (Rezwana and Pain 2020) Moreover, social norms

around dress codes and female bodies (Rashid 2000 and b; Rashid and Michaud 2000 and b) hinder women's ability to escape danger during hazards, adding another dimension of stress (Rahman 2013a and b; Kabir 2014; Kabir et al. 2016;). Issues of sexual assault are not only intensely traumatizing but also entangled with social norms whereby girls can lose their honour and become 'unmarriageable', adding to family tension and economic instability (Ahmed et al. 2019a and b; Rezwana and Pain 2020).

3.3 Social tension and conflict

Increased family tensions constitute another major risk to mental wellbeing in the context of climate change. Two key areas of social strain identified in this review are violence towards children and women.

3.3.1 Child abuse and injury

Environmental hazards can confer an increased risk of child abuse and injury. When large parts of family homes are inundated by floodwater, children are confined to rooms where dangerous cooking utensils are more accessible and can sustain injuries while their mothers are busy with household tasks. Muddy floors after floods pose risks of falls and fractures, while burns, drowning, and animal bites also pose risks of injury and trauma (Biswas et al. 2010a and b). Often, many family members are concentrated in one household post-cyclone where children sharing beds with extended relatives can suffer molestation and sexual abuse (Akhter et al. 2015; Azad and Khan 2015). Floods can also increase violence towards children. One study, for example, found that up to 70% of mothers and 40% of fathers in flood affected areas have abused their children, where it was reported that parents under extreme mental pressure were unable to control their emotions. Children experiencing violence are more likely to experience medical and psychological problems such as depression, eating disorders, PTSD, and chronic pain (Biswas et al. 2010a and b).

3.3.2 Gender roles and domestic tensions

Another crucial source of societal and family tension post-disasters relates to gender roles. Floods and cyclones add to the workload of women, whose daily tasks become more time-consuming. Water insecurity due to floods and salinification means women must travel further to collect water for drinking and cooking (Islam 2010; Azad et al. 2013; Habiba et al. 2013; Rahman 2013a and b; Sugden 2014; Tasdik Hasan et al. 2020); these longer distance trips take time and energy from other household duties such as preparing food (Habiba et al. 2013). Women struggling to serve meals on time can suffer verbal and physical abuse from their husbands (Biswas et al. 2010a and b; Azad et al. 2013; Habiba et al. 2013; Sugden 2014; Azad and Khan 2015), violence when asking their husbands for money to buy food (Rashid 2000a and b), or increased stress when having to borrow food from neighbours (Ferdous and Mallick 2019). These problems managing household requirements are compounded by food scarcity due to loss of crops and agriculture (Deb and Haque 2011; Alam and Rahman 2014). As a response to food insecurity women tend to eat less, leading to malnutrition (Islam 2010) and decreased energy levels, further impairing their ability to 'perform their gender roles', and exacerbating domestic tensions (Azad et al. 2013; Rahman 2013a and b). The impacts of domestic violence are reported to be more severe for women who have experienced other

trauma such as disasters (Shahriar and Shepherd 2019). Women who experience gender-based violence after cyclones experience fear, helplessness, decreased self-confidence, and symptoms of PTSD as well as physical injuries which are often left untreated (Rezwana and Pain 2020).

Gender-enforced restrictions and the rule of purdah (requiring women to stay in the home unless accompanied outside by a male relative) impede women's access to information about floods and cyclones. This hampers their safety (Rahman 2013a and b), as well as their ability to prepare for events and fulfil their role as caregivers (Nahar et al. 2014b). Besides domestic abuse, women who fail to perform family duties suffer feelings of guilt, depression, and anxiety under the expectations of their families (Choudhury et al. 2006; Azad et al. 2013; Nahar et al. 2014a and b). Moreover, women who are already psychologically traumatized are more likely to struggle with workloads (Choudhury et al. 2006), creating a vicious cycle of tension.

Finally, the salinification of drinking water due to sea level rise leads to increased rates of traumatic complications in birth and pregnancy, such as gestational hypertension, premature abortion, and postpartum haemorrhage (Islam 2010; Begum 2017). The literature also reports on mothers giving birth to disabled children, linked to the immense mental and physical trauma of disasters (Kabir 2014; Kabir et al. 2016).

3.4 Livelihood loss and economic hardship

Livelihoods and employment in Bangladesh are, just as female gender roles, closely linked with natural resource pressures. Climatic stress exacerbates poverty by destabilizing agricultural productivity (which constitutes a major part of Bangladesh's economy), thereby inflating mental health risks across the country.

3.4.1 Declining productivity, poverty, and unemployment

Drought, salinification, and floods all decrease agricultural productivity (Habiba et al. 2013; Sugden 2014; Azad and Khan 2015; Ayeb-Karlsson et al. 2016; Kabir et al. 2016; Deb and Haque 2017). Direct damage to crops, livestock, and fishing spots from natural hazards (Kabir et al. 2016), and loss of land due to erosion (Sugden 2014) and saline intrusion (Deb and Haque 2011) create livelihood instability. Poor villages that highly depend on natural resources are particularly impacted (Ferdous and Mallick 2019). Seasonal temperature changes affect access and ability to work which can be frustrating, sad, stressful, and worrisome. Besides the direct financial losses from lost productivity to families, major portions of income (Yasmin and Ahmed 2013) and time are spent on repairing houses, leaving people unable to enter paid work (Kabir et al. 2014).

Unemployment leaves people with more time to dwell on bad experiences, erodes self-worth, and can lead to suicidal ideation (Kabir 2018). Boredom and a lack of purpose may result in increased drug and alcohol use (Kabir 2018; Tasdik Hasan et al. 2020), while male idleness and loitering aggravate the chances of eve-teasing and female harassment (Rashid 2000 and b). Children of unemployed fathers are reported six times more likely to be injured during floods, due to parental violence or unintentional injuries (Biswas et al. 2010a and b). Financial poverty from unemployment is a considerable source of misery and trauma in itself (Kabir 2014; Kabir et al. 2014) and has further downstream consequences for wellbeing.

3.4.2 Child marriage and dowry

By aggravating economic insecurity, climatic stress appears to indirectly increase child marriage rates in Bangladesh. Marriage is partly viewed as a financial transaction whereby dowry payments are a means of capital accumulation. Early marriage is therefore a common coping mechanism for impoverished families (Yasmin and Ahmed 2013; Alston et al. 2014; Deb and Haque 2017; Rahman et al. 2019; Rezwana and Pain 2020). Marrying children minimizes household expenses and increases food security (Ahmed et al. 2019a and b; Ferdous and Mallick 2019) and access to relief supplies (as disaster relief is distributed per family) (Akhter et al. 2015). The dowry of a child also tends to be less than that of an adult woman, and dowries are cheaper during floods and cyclones, prompting impoverished families to arrange marriages quickly. This is compounded by the closure of schools, as when girls stay at home, they are more likely to be married. Marriage is also a strategy to protect girls from sexual violence during disasters (Alston et al. 2014; Ahmed et al. 2019a and b); however, girls married young are more vulnerable to exploitation by the husband's family and physical violence (Alston et al. 2014). Failure to maintain dowry payments can cause conflict and violence against married women (Alston et al. 2014; Ferdous and Mallick 2019; Rezwana and Pain 2020), with girls being 'justifiably' mistreated and abandoned by their new relatives (Rashid and Michaud 2000 and b).

3.4.3 Loan pressures

Common climate change adaptation strategies include lending money from NGOs, money-lenders, or the rich to manage financial insecurity (Alston et al. 2014; Sams 2019). However, loans put families under mental pressure, and the climatic stress makes it more difficult to grow crops. This may result in failure to repay loans (Kabir et al. 2016) forcing people to sell land, livestock, and precious possessions or indulge in cheap labour to repay loans and interest (Yasmin et al. 2013). Debt stress is a considerable source of anxiety and worry (Rashid 2000 and b; Yasmin et al. 2013; Alston et al. 2014) but can also trigger conflict. Unpaid debts may provoke land-grabbing of homesteads by moneylenders (Deb and Haque 2017), land bandits, or blooded conflicts over borrowed money (Yasmin and Ahmed 2013). Besides economic hardship, household dependency on micro-credit loans is also a risk factor for child abuse and injury, with debt having a negative psychological effect on already overburdened parents (Biswas et al. 2010a and b).

3.4.4 Alternative livelihoods

Switching to alternative livelihoods is another common adaptive response to climate-induced livelihood instability. This can compel people to take up illegal activities, or enter unsafe and protected environments, such as going into the Sundarbans for logging or to collect fish and honey (where tiger and pirate attacks are a risk) (Kabir et al. 2016), or fishing in rough seas, (Rashid 2013) to allow survival and debt repayment. These activities create mental pressures and stress for family members who live in perpetual uncertainty and fear for their loved ones. Loss of family livelihood may also push children into exploitative and dangerous labour, where they are vulnerable to financial, emotional, and sexual abuse (Akhter et al. 2015; Azad and Khan 2015). Switching livelihood generates conflicts over resources (such as where people are allowed to fish or sell their catch) that may turn violent (Ayeb-Karlsson et al.

2016). The switch from rice to shrimp farming due to salinification or commercial pressure (Habiba et al. 2013) requires high capital investment, pressuring smallholder farmers to sell land to local elites, and become landless which feeds social disintegration. The controversy of shrimp culture feeds disputes between local and outside landowners, and between rice and shrimp producers (Habiba et al. 2013). Finally, due to patriarchal social norms, women sometimes cannot access livelihoods outside the household, further exacerbating their economic insecurity (Ferdous and Mallick 2019).

4 Discussion

Environmental stress exacerbates mental health risks in Bangladesh, in the short and long term, and on multiple levels. The climate-wellbeing relationship is highly complex with close overlaps between the thematic areas. Many of the links are strongly mediated by gender inequalities. This is consistent with climatic impacts elsewhere, as household stress, migration, and reduced assets intensify life pressures for women (Rao et al. 2019). However, results of other studies suggest that there are also specific gender vulnerabilities for men, such as increased all-cause mortality due to heat effects. This may be due to increased male exposure to heat through working outside during heatwaves (Burkart et al. 2014). How and if this increased mortality risk relates to mental health outcomes would be an important area to study further. Recently, more research in Bangladesh focusses on the psychological impacts of social gender roles for men, who experience anxiety and distress from the duty to protect the lives of family members during a cyclone strike, or from urban risks post-migration (Ayebe-Karlsson 2020a, 2020b). These differential impacts on women and men are founded in historical and current social inequalities and norms. Gender must form a central theme in climate change mitigation and adaptation policies, in order to alleviate the disproportionate damage upon women's and children's psychological health.

The systems network often involves processes where pre-existing socio-economic vulnerabilities are further exacerbated by environmental stress, causing impaired mental wellbeing. Poverty predisposes people to the mental health impacts of climate change, while the impacts further exacerbate poverty. This forms a vicious cycle in which disadvantaged groups suffer disproportionately and are locked into vulnerable positions (Islam and Winkel 2017). Poverty reduction is thus vital to mitigate the mental health risks of climate change. Genuine mental health progress cannot be made without coordinated action on the drivers of climate change vulnerability. We also need to invest in people-centred mental health services, where solutions must target planetary systems to remove the upstream causes of mental ill-health (Jackson and Devadason 2019).

The systems map from this literature review provides a framework to guide much needed research on climate change and mental health in other countries where increased understanding is essential. It may be that certain aspects of these results reflect the climactic, cultural, and political context of Bangladesh, specifically, and thus are not generalisable to other settings. For example, the unique climate vulnerability profile of Bangladesh means that its array of environmental stressors is highly diverse, inflicting damage in various ways that may not occur elsewhere. Contextual practices relating to gender-enforced restrictions (such as the rule of purdah and the impact of this on women's experiences of evacuation) may be another feature that uniquely shapes these findings. However, societal gender features (within and beyond Bangladesh) must similarly to other collectively reproduced and transformative values be seen

through a post-colonial lens, recognizing the influence of colonial history on current cultural practices and power relations.

However, other aspects are likely more generalisable. The vital connection between people and their land, and how climate-related agricultural losses cause suffering through a host of different pathways spanning nutrition, economic insecurity, unemployment, and domestic tensions may be one such universal phenomenon. Societies that are highly dependent on natural resources are especially vulnerable to climate-induced economic hardship when fertile land is encroached upon by environmental stressors, or when productivity decreases due to heat-related fatigue (Kjellstrom et al. 2009; Padhy et al. 2015). Economic hardship subsequently feeds mental ill-health through a variety of pathways, from socio-political instability to feelings of helplessness and suicide (Berry et al. 2010; Cianconi et al. 2020).

Similarly, the need to migrate (either temporarily, seasonally, or permanently) in response to climatic changes, and how this may undermine mental wellbeing through loss of belonging or newcomer hostility, may be a more universal phenomenon. The resultant disruption to social ties is a key mechanism by which mental health can be damaged (Torres and Casey 2017).

Even though key concepts and links may vary between social cultures and geographical contexts, a systems approach offers a valuable way to explore and visualize the complex relationships between climatic changes and wellbeing in diverse research settings. The systems map clearly illustrates how key pathways of vulnerability and damage actively mediate mental (ill)health. These pathways provide tangible opportunities for intervention and health risk reduction that can serve as focal points for research both within and beyond Bangladesh.

This study revealed that very little research focussed specifically on the mental health impacts of climate change in Bangladesh. This highlights a further need for critical investigations in this area. The relationship between climate-related (im)mobility and mental wellbeing is one area where more empirical research is needed. Future research should investigate this in depth, exploring the intertwining of natural, social, and psychological factors that influence decisions to move (or stay), while recognizing the various types of mobility (nuanced by elements such as distance, time, voluntariness, and vulnerability).

A wellbeing approach is potentially also more effective and appropriate than a ‘western’ framing of mental illness. This, along with a systems approach, permits a wider understanding of the problem as well as a wider scope for solutions. The need to understand the wellbeing effects of climate change is crucial although complex and challenging to isolate (as mental health is entangled in broader socio-politico-economic contexts and not corporal like physical ill-health). Enhanced understanding of the wellbeing impacts would allow healthcare providers to be stronger advocates for climate change mitigation and adaptation (Maughan and Berry 2015), while supporting health professionals to prevent and anticipate climate-induced patterns of ill-health (Hayes et al. 2018). This could present mental health opportunities in a changing climate, where climate adaptation and better prioritized action increase social cohesion and empowerment (Berry 2009).

5 Conclusion

This study provides a wealth of evidence for the damaging impacts of climate change on mental health in Bangladesh. The findings highlight key areas of mental health risk which can be further investigated by future research such as mental health aspects of climate-induced

(im)mobility and domestic or social tensions. Meanwhile, the vulnerabilities identified should be prioritized as central themes for climate policy. The systems map provides a framework to guide similar research studies in other countries. Key concepts and links may vary between socio-cultural contexts, but the systems approach offers a useful tool to explore the complex relationships between climatic changes and wellbeing.

We must remember that these are human lives and minds who bear the stress imposed by an environment that people have limited to no control over. These impacts span through all areas of life, and are amplified by pre-existing vulnerabilities to poor psychological health. Greater recognition and action are urgently required, for those who will, and for those who already suffer the psychological consequences of climate change.

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Availability of data and material Secondary data are fully open and available.

Code availability Not applicable.

Declarations

Ethics approval All procedures performed were in accordance with the ethical standards of the institution at which the studies were conducted and ethical approval was obtained from the BSMS Research Governance and Ethics Committee (RGEC).

Consent to participate Not applicable.

Consent for publication The authors give the publisher the permission to publish the work.

Conflict of interest The authors declare no competing interests.

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