



## Waiting for the wave, but missing the tide: Case studies of climate-related (im)mobility and health

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### ABSTRACT

Climate change amplifies health risks, including through the health impacts of climate-related displacement. Yet diverse mobility responses in a warming world can also provide a pathway for climate change adaptation. This article examines the connections between climatic and environmental change, human mobility and health. It presents case studies across three countries: Fiji, Bangladesh, and Burkina Faso. All case studies used qualitative methods, including semi-structured interviews, storytelling, and group discussions. The Fiji case study focuses on relocation of a coastal village exposed to erosion, flooding and saltwater intrusion; it highlights self-reported health risks and opportunities following relocation. The Bangladesh case study includes seven sites that variously experience flooding, cyclones and riverbank erosion; while residents use migration and (im)mobility as a coping strategy, there are associated health risks, particularly for those who feel trapped in new sites of residence. The case study from a village in Burkina Faso examines seasonal labour migration to the Ivory Coast and Mali during times of drought and reduced agricultural productivity, and discusses health risks for men who migrate and for women who remain in sending communities. These case studies illustrate that there is no consistent figure that represents a 'climate migrant', 'climate refugee', or 'trapped' person. Accordingly, we argue that where planetary health looks to highlight 'waves' of climate displacement, it may miss the 'tide' of slower onset climatic changes and smaller-scale and diverse forms of (im)mobility. However, even where climate-related mobility is broadly adaptive - e.g. providing opportunities for livelihood diversification, or migration away from environmental risks - there can be health risks and opportunities that are shaped by socio-political contexts, access to healthcare, altered food sources, and living and working conditions. Responsive solutions are required to protect and promote the health of mobile and immobile populations in a warming world.

### 1. Introduction

The impacts of anthropogenic climate change on human migration and mobility are increasingly cast as a global priority (Parsons and Nielsen, 2021; Nash, 2018). There is growing interest in the connections between climate change, migration, and human health (Abubakar et al., 2018; Ayeb-Karlsson, 2021; Hunter et al., 2021; McMichael, 2020; Schwerdtle et al., 2020; Shultz et al., 2019). 'Big picture' accounts, commentaries and reviews discuss the potential intersections between climate change, migration and health (Schwerdtle et al., 2018). Some

quantitative analyses overlay population and climate data with health indicators to unpack climate-migration-health intersections, although often limited by low-resolution datasets particularly in low-income countries (Romanello et al., 2021; Eklund et al., 2016). There are calls for smaller scale studies on the health consequences of human (im)mobility in a changing climate (Parsons and Nielsen, 2021; Karki et al., 2020; Ridde et al., 2019). However, few empirical studies examine climate-mobility-health links at the scale of local populations in places of climatic and environmental risk.

In this article, we present findings from qualitative case studies

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across three countries - Fiji, Bangladesh, Burkina Faso - and highlight perceived connections between local climatic and environmental change, (im)mobility, and health risks and opportunities. We use the term (im)mobility to refer to different forms of climate change-related human mobility, including for example planned relocation, circular labor mobility, urban migration, and immobility and/or trapped populations.

The **Fiji** case study discusses the health of residents of Vunidogoloa following planned relocation from a low-lying coastal site with escalating risks including flooding and erosion. This village has been identified as an early example of climate-related relocation, and the first in Fiji to relocate with government and donor support (Worland, 2019). Residents report consequences for health following relocation linked, for example, to altered diet, social networks, place attachments and living conditions. The **Bangladesh** case study explores links between migration, immobility and health across seven climate-vulnerable sites: three rural/coastal, three rural/inland, and one urban slum that accommodates migrants from Bhola Island affected by cyclones and riverbank erosion (Ayebe-Karlsson et al., 2016; Ayebe-Karlsson, 2020; McNamara et al., 2016). Bangladesh is located in the world's largest delta, and is highly exposed to environmental and climatic stressors (Ayebe-Karlsson et al., 2016). Across the seven case study sites, residents sought to cope with environmental and climatic stressors and disrupted livelihoods through migration, and highlighted associated health threats of (im) mobility and altered livelihoods (Ayebe-Karlsson, 2021; Ahmed et al., 2019). The **Burkina Faso** case study examines first-time out-migration in Bourasso village. Burkina Faso is experiencing decreasing annual precipitation and temperature extremes (IPCC, 2021; Pearson and Faso, 2018). Heatwaves and droughts contribute to low or failed harvests and threaten rain-fed subsistence agriculture and livelihoods (Mank et al., 2021; Vinke et al., 2021). In Bourasso, residents adopt adaptation strategies to cope with climatic and environmental changes including seasonal labour migration of men to the Ivory Coast and Mali to work on sugar cane plantations and in gold mines. Seasonal migrants and their wives, remaining in place with children, report health risks associated with difficult working conditions, food insecurity, and infectious disease (Vinke et al., 2021).

These are not case studies of large-scale climate-related forced displacement, but highlight the smaller scale but nonetheless significant ways in which people move from and to sites of climate risk. We argue that health is an important measure of the effectiveness and adaptive potential of mobility. Through these case studies - from Fiji, Bangladesh and Burkina Faso - we provide insight into the uneven health opportunities and vulnerabilities for (im)mobile populations in a warming world.

## 2. Background: planetary health and climate-related mobility

Planetary health underscores the ways in which human activities in the Anthropocene disrupt Earth's ecological systems with consequent threats to human health. It examines the impacts of human activity to the health and sustainability of Earth systems, and seeks to analyse and address the risks to human health from environmental change (Schutte et al., 2018). Anthropogenic climate change is understood to represent one such risk to human health, including through relatively direct pathways such as extremes of heat as well as more complex pathways such as health risks of climate-related migration and displacement (Schutte et al., 2018; Frumkin and Myers, 2020).

Climate-related disasters - such as extreme weather events, rising sea levels, land degradation - in combination with other stressors including disrupted livelihoods, are expected to contribute to displacement as a strategy of last resort (Schutte et al., 2018; Myers, 2018; IDMC, 2021). Following disaster (and noting that not all environmental disaster is linked to climate change), displaced people can experience inadequate access to water and sanitation, poor shelter, undernutrition and micro-nutrient deficiencies, elevated rates of infectious disease, and

poor mental health (Kabir et al., 2016; Loebach and Korinek, 2019; Rahaman et al., 2018; Whitmee et al., 2015; Lancet (Editorial), 2020). For example, the report of the Rockefeller Foundation/Lancet Commission on Planetary Health highlights health risks of displacement following disaster (e.g. 2010 Pakistan floods) (Whitmee et al., 2015). Discussions around planetary health often refer also to connections between climate-related conflict, displacement and health. While no straight-forward causal connection can be drawn between climate change and conflict (Buhaug et al., 2014; Hsiang and Burke, 2014; IPCC, 2014), many refer to the threat of climate-related conflict. Such thinking has proven as sticky as it is simplistic; as the narrative goes, climate-related disaster (such as drought), leads to civil conflict, which precipitates population displacement, with adverse consequences for health (Abel et al., 2019; Bettini et al., 2017). Yet there is no consensus as to whether climate-related conflict will contribute to migration, or whether climate-related migration will act as a catalyst for conflict (Burrows and Kinney, 2016). The climate-conflict-migration-health nexus is particularly difficult to analyse and interpret.

Climate-related disaster, conflict and 'mass migration' capture public and policy attention, and are widely referred to in the field of planetary health, including through references to 'climate refugees'. For example, a recent paper on planetary health and the effects of climate change on children warns that 'climate refugees' are vulnerable to health risks resulting from 'dislocation' (Williams et al., 2021). The concept of 'climate refugees' draws attention to inequitable climate risks, yet the concept is increasingly out of favour due to the lack of legal basis, recognition that mobility is a form of climate adaptation, and concerns that it positions people as passive victims (Gemenne, 2015; Methmann and Oels, 2015; Baldwin et al., 2019; Dreher and Voyer, 2015; Lister, 2014).

We argue that where planetary health looks to highlight waves of climate displacement and 'climate refugees', and consequent risks to health, it misses the tide of slower onset climatic changes and smaller scale (im)mobility (Bettini, 2013; Zickgraf, 2021). These forms of climate-related mobility can also incur health risks and opportunities. For example, in the Marshall Islands, a low-lying Pacific atoll nation-state, there are signals that environmental stress - drought, high tides, heatwaves - intersect with migration drivers and contribute to urban migration. While urban centres provide access to healthcare, urban living has health risks due to higher reliance on imported unhealthy foods, crowded living conditions and inadequate water and sanitation (van der Geest et al., 2020; Brewington et al., 2021). There are also health consequences of small-scale relocation from sites of climate risk (Dannenbergh et al., 2019). In the Solomon Islands, for example, some residents of relocating coastal villages report poor water and sanitation facilities, social isolation, and limited healthcare access, others highlight improved access to fertile land and cleaner water (Albert et al., 2018). Migrants can also move to places with climate-related threats to health (Adger et al., 2021; Watts et al., 2020; Sellers et al., 2019; Smith et al., 2014). In California, undocumented migrants were found to be disproportionately exposed to the effects of climate-related wildfire (e.g. 2017-18 Thomas Fire) due to inadequate access to information, limited workplace protections from air pollution, and ineligibility for disaster relief funds (Méndez et al., 2020). And migrant labourers in India and some Middle Eastern countries are vulnerable to extreme outdoor heat and experience heat-related morbidity and mortality (Lundgren-Kownacki et al., 2018; Pradhan et al., 2019). So, it is important to consider and address the health consequences not only of forced displacement but also other forms of climate-related mobility including urban migration, relocation, and migration into sites of climate risk.

Further, there are involuntarily immobile or trapped populations who, despite wanting to move from places of risk, lack resources or capacity to move or are 'left behind' and may face threats to health (Ayebe-Karlsson, 2020; Ayebe-Karlsson et al., 2018; McLeman et al., 2021; Black et al., 2011; Foresight, 2011). Dozens of Alaska Native Villages are

experiencing flooding, erosion, melting permafrost, and later snowfall. In Shishmaref, Alaska, residents are keen to relocate, but lack of funding and political commitment mean they are trapped in place; this causes significant stress with adverse consequences for mental health (Wolsko and Marino, 2016). In Newtok, Alaska, while some residents were relocated in 2019 to higher ground, construction delays mean that most people remain in the old settlement where there is little incentive to invest in health-promoting infrastructure, no running water, limited sanitation, inadequate waste treatment and unreliable power generation (Eichelberger, 2018; Ristroph, 2021). Migrants themselves can also become trapped, unable to return home or move to safer destinations, and this can result in distress, anxiety and limited life satisfaction (Ayebe-Karlsson, 2021; Ayebe-Karlsson, 2020; Adger et al., 2021; Sza-boova et al., 2021; Schwerdtle et al., 2021). Yet people also choose to stay in places of climatic risk due to social networks, place attachment, and religious or political reasons (Zickgraf, 2021; Biswas and Mallick, 2021).

In sum, climate-related (im)mobility takes a wide range of forms. And the health consequences of human migration and mobility in a warming world are contingent on social, environmental and political factors as well as individual and household characteristics. As a recent systematic review of migration, health and climate change states, the “relationships between migration and health in the context of climate change are strongly heterogeneous” (Schwerdtle et al., 2020) making it difficult to derive general conclusions. Nevertheless, it is important to document and to better understand these diverse experiences of the climate-mobility-health nexus.

### 3. Methods

The Fiji research occurred over a five-year period (2015–2020), and included data collection at four time points: 2015, 2016, 2019 and 2020. The Bangladesh research took place over a five-year period (2013–2018), and included data collection at six time points: 2013, 2014, 2015, 2016. The Burkina Faso data collection occurred in 2017. As mentioned above, the case study sites were selected as they represent places of climatic and environmental stress in which (im)mobility responses are occurring (Worland, 2019; Ayebe-Karlsson et al., 2016; IPCC, 2021; Pearson and Faso, 2018; Mank et al., 2021; Vinke et al., 2021).

The case studies employed qualitative methods including: semi-

structured interviews, group discussions, and storytelling in which people recounted narratives without unnecessary interruption. These methods were used and adjusted in ways that were appropriate to the socio-cultural context. For example, ‘*talanoa*’ research is a form of group discussion based on shared storytelling that is common across the Pacific Islands. Data were collected around socio-economic context, perceived environmental and climatic change, (im)mobility, and subjective accounts of health (Ayebe-Karlsson et al., 2016; Vinke et al., 2021; McMichael and Powell, 2021). The Fiji case study, Vunidogoloa (see Fig. 1), examined local experiences of planned relocation, including the impacts for housing, livelihood opportunities, farming and food security, socio-cultural identity, social networks, land and fishing ground tenure, and access to health services. The Bangladesh research, across seven sites (see Fig. 2), included a focus on livelihood security, health, and mobility as well as longer-term immobility among people who have moved into or failed to evacuate urban contexts of environmental risk (Ayebe-Karlsson, 2021; Ayebe-Karlsson et al., 2016; Ayebe-Karlsson, 2020). The Burkina Faso case study, Bourasso (see Fig. 3), examined local experiences of seasonal labour migration, both from the perspective of men who moved and women/wives who remained in sending communities. The experiences focused on livelihood diversification, food insecurity, and self-reported health consequences and risks of seasonal migration.

The case studies were designed and conducted by the authors (Fiji - CM; Bangladesh - SAK; Burkina Faso - PNS), in collaboration with local and international researchers and community leaders. Data were collected from people aged  $\geq 18$  years (age range 18–84), and participants with diverse backgrounds were included (e.g. age, gender, ethnicity, religion, class, migration histories, livelihood). The Fiji case study included qualitative interviews with 27 people (14 men, 13 women), four of whom participated in interviews across multiple points of data collection, and five key informants (local government, community health workers). In addition, six group discussions with between eight to twelve participants were conducted. All participants were iTaukei (Indigenous). The Bangladesh case study included in-depth interviews with 36 participants (2-3 interviews each), 16 key informant interviews (approximately 30 interviews), and 86 group discussions involving 700–1000 participants in total; the gender balance was fairly even. Interviews were conducted in homes, communal spaces (such as shared outdoor village areas, village halls) and some were walking



Fig. 1. Map of Vunidogoloa, Fiji (prepared by Chandra Jayasuriya).

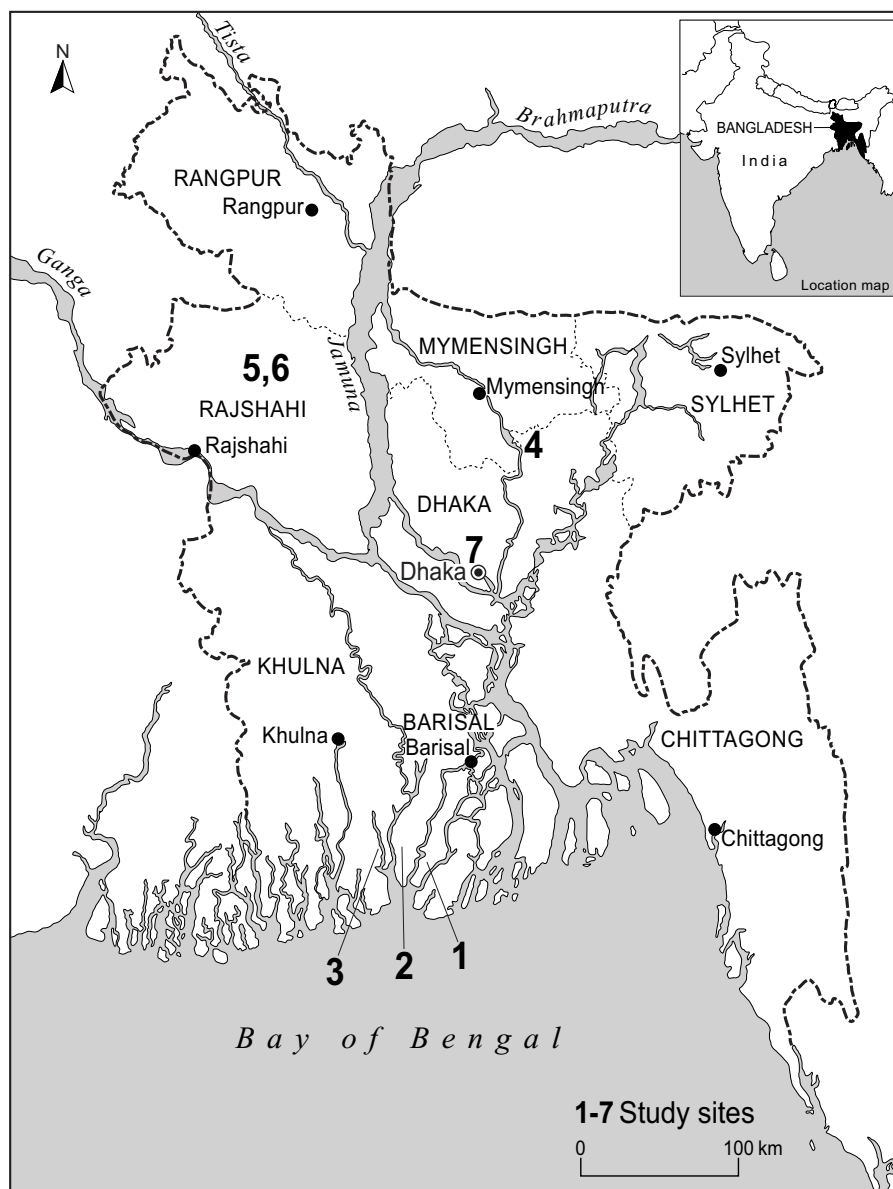


Fig. 2. Map of seven study sites, Bangladesh (adapted by Chandra Jayasuriya from map prepared by Aileen Orate, UNU-EHS/UNU-VIA Communication Unit 2015).

interviews that enabled place-based conversation and observation. The Burkina Faso case study included 52 qualitative interviews with 30 migrant men who had recently returned to Bourasso, 18 migrant wives who remained in Bourasso, and four key informants (village leaders, local agricultural specialists (Table 1).

Recruitment was enabled through the networks and knowledge of local researcher counterparts, community leaders, and snowball sampling. In Fiji, participants were identified by the village head-man, through self-nomination during or following communal discussions, via snowball sampling, or opportunistically during fieldwork. In Bangladesh, gatekeeper and respondent-driven sampling (or snowball sampling) facilitated recruitment, whereby existing participants suggested and/or recruited subsequent respondents from among their acquaintances. In Burkina Faso, interview participants were selected from a list provided by village leaders who identified households with members who migrate.

Data collection was conducted in English or local languages/dialects (i.e. Fiji – English, Fijian and Cakaudrove dialect; Bangladesh – Bengali; Burkina Faso - Bwamu and Dioula) with translation provided by local research counterparts. Interviews and group discussions lasted from 30

minutes to three hours. Interviews and group discussions were digitally recorded and transcribed, or recorded as written notes. Data were variously analysed using thematic content analysis (Fiji, Burkina Faso, Bangladesh), livelihood history analysis (Bangladesh) and grounded theory (Fiji, Burkina Faso). Thematic content analysis provided a means to code the data, identify themes, and identify representative quotes (Guest et al., 2012); using a grounded theory approach, coding acted as a tool for analysis, building hypotheses and insight from the data; and livelihood history analysis provided focus on people's adaptation responses, including livelihood adaptation, in contexts of environmental stress and shocks. Human research ethics approval was provided by relevant Universities and local authorities for all three case studies. In Fiji, research permits were also granted by the Government of Fiji, and research approval was provided by the Cakaudrove Provincial Councils and the *Turaga ni Koro* (village headman). In Burkina Faso, research was approved by the Nouna Ethical Committee.



Fig. 3. Map of Bourasso, Burkina Faso (prepared by Chandra Jayasuriya).

**Table 1**  
Participants across study sites in Fiji, Bangladesh and Burkina Faso.

	In-depth qualitative interviews or storytelling	Key informant interviews	Group discussions / collective storytelling
Fiji	27 participants (14 men, 13 women)	5	6 discussions (approx. 42 participants)
Bangladesh	36 participants (approx. 50/50 gender balance)	16 participants (30 interviews)	86 discussions (approx. 700-1000 participants)
Burkina Faso	48 participants (30 men; 18 women)	4	-

## 4. Results

### 4.1. Vunidogoloa, Fiji: planned relocation

In Vunidogoloa, planned relocation led to both improved conditions for health and new health risks. In Fiji (pop. 896,444), numerous coastal villages and settlements are identified as vulnerable to sea-level rise and associated impacts. A few have moved or retreated with government support; some are retreating autonomously (McMichael and Powell, 2021). Residents of the coastal village of Vunidogoloa relocated in 2014. Government Ministries and donor agencies contributed funding and resources; community members provided labour and some building materials. The new site is on *mataqali* (clan) land, within walking distance to the old village site.

Residents recall that the old village (26 households, pop. ~140) experienced worsening coastal flooding and erosion, saltwater intrusion and seawall failures, changes they attributed to climate change. As one woman explained, *‘the reason we moved was because of climate change. When it is during heavy rain or bad weather the river flooded and meet with the tides which floods the village’* (Woman, 2019). Several people recalled that the old site was increasingly unhealthy, as it had become ‘soggy’ and ‘water-logged’. Subsistence gardens and fruiting trees were destroyed by saltwater, and homes damaged by high tides, waves and flooding. As one woman said, *‘before in the village when it was high tide and*

*the rain came, the flood comes up inside the village. The water was up to our knees’* (Woman, 2020). While planned relocation reduces exposure to escalating coastal risks, it has altered the determinants of health.

There are several perceived health benefits, many linked to improved resources and access to health and educational services. New houses consist of one open-plan room, a shower receptacle and flush toilet with septic tank (the old site had shared pit latrines), a washing basin supplied by gravity-fed spring water, and a small solar panel for electricity. Residents have added kitchens with wood-fire stoves, constructed from salvaged materials. One woman described improvements in living conditions, saying *‘we are healthier here, it’s good here. In the old village, in one house there were four families sleeping together. That’s very hard. Only one pit toilet per house, for three families inside one house. . . But here we have flush toilets’* (Woman, 2020). Residents report increased production of cash crops (e.g. pineapples), greater proximity to farmland where people grow food crops, and healthy kitchen gardens. As one community leader explained, *‘vegetables, cash crops, we can’t plant that because of the sea water in the old site [because of] salination; now we have pineapples, tapioca, dalo [taro], bananas’* (Man, 2015). There is increased access to local health services and hospitals due to closer proximity to the road and availability of local transport services, and residents and healthcare workers report associated improvements in village vaccination coverage and management of chronic health conditions.

However, residents report new risks to health due to disrupted place attachment, altered diet and, disrupted social networks. For example, while the new site is within ancestral *mataqali* land people describe lost attachments to homes, fishing grounds, the ocean and tidal rhythms, and ancestral burial grounds. In Fiji, there are important links between iTaukei people, traditions and social institutions, and traditional land and fishing grounds with which they identify (Ravuvu, 1983). One woman explained she would prefer to live near the sea because she could swim and catch seafood *‘to feed the children and all the family’* (Woman, 2020).

Diets have reportedly changed due to increased proximity to the road and urban centres, relocation away from fishing grounds, and increased production of cash crops. Whereas at the old site there was *‘plenty of seafood, easy to catch and eat’* (Man, 2020) and *‘we stay healthy’* (Woman,

2020), many people said they now eat less fresh seafood and more packaged foods including tinned fish, biscuits, rice, flour and noodles.

*We were healthier down there, at the old village. We lived away from the main road. With the road comes pollution, dust; we are far from the sea. At the old village we had fresh air coming from the sea, plenty of seafood easy to catch and eat; fresh. Just twenty minutes; catch then boil the fish. Here, plenty of times, if you don't go to the sea you drink tea and eat tinned dish.* (Man, 2020)

Some suggest this has led to poor health, particularly diabetes and tooth decay. While transitions to a Western diet and sedentary lifestyles are occurring widely in Fiji and the Pacific Islands, planned relocation may have increased the pace of transition.

Relocation has disrupted some social structures. The traditional village layout has been replicated with a communal hall to meet and sustain governance structures, and a church funded and built by villagers. Yet the village has shifted from multi-family to smaller households, and many miss social connections and sharing of resources within extended households. As one woman said, people are increasingly focused on 'their own small family' rather than 'the big family' (Woman, 2020). Some reported increased tensions and interpersonal violence in smaller households. Others suggested that access to neighbouring settlements and urban centres has brought problems and 'disturbance from outsiders', including new religious denominations, reduced commitment to traditional laws, and increased alcohol consumption. It is unclear whether these changes are due to relocation or to broader diminution of traditional practices (Balick et al., 2019), however many suggest socio-cultural transitions are undermining foundations for good health.

In sum, Vunidogoloa's planned relocation from a site of coastal risk has led to both health risks and opportunities: residents report changes to diet and increased consumption of packaged foods, disrupted social networks, loss of place attachment, as well as some improvements to living conditions, livelihood opportunities and healthcare access.

#### 4.2. Bangladesh: urban immobility and migration from rural areas

In multi-sited research in Bangladesh across coastal, inland and urban sites, participants indicated that migration and (im)mobility provide pathways to cope with livelihood stress but also lead to health risks. Bangladesh (pop. 164.7 million) experiences diverse environmental stressors (Ayeb-Karlsson, 2020). Participants referred to climate change impacts and environmental hazards as drivers of mobility or migration, often highlighting the need to move in search of alternative livelihoods (Ayeb-Karlsson et al., 2016; Ahmed et al., 2019; Ayeb-Karlsson et al., 2019). Some participants said drought and lack of rainfall reduced agricultural employment opportunities in their villages: 'My husband goes to Dhaka during drought [and dry spell] because those periods mean less crops and less work' (Woman, aged 31) (Ayeb-Karlsson et al., 2016). Others were affected by heavy rainfall and floods, or riverbank erosion:

*I experienced the extreme effect of riverbank erosion in 2010 when 25 houses [in the village] went under water over a night. Several crop fields were also damaged. We lost everything' (Man, aged 55) (Ayeb-Karlsson et al., 2016).*

*'When I was a child we used to eat rice from our own fields. After [the riverbank erosion] we never got to eat rice from our fields again . . . The food scarcity came with the riverbank erosion' (Woman, aged about 60) (Ayeb-Karlsson et al., 2016).*

Migration to urban centres or sites with alternative livelihood opportunities (e.g., construction work, rickshaw pulling, garment and brick factory labour) often led to difficult working conditions with increased risk of injuries, longer-term physical health impacts, and increased health care expenses that contributed to escalating debts (Ayeb-Karlsson, 2021; Ayeb-Karlsson et al., 2016). A young woman who

found factory work carrying bricks said she now looks much older because the work 'is hard and it breaks you down' (Woman, aged 33). Another woman described how her husband was injured at work and experiences ongoing health problems:

*'My husband cannot work properly as he had an accident. While cutting mud on a hill he was struck by a sudden landslide. There was a pipe inside the hill and it broke creating a landslide and he fell down in a hole [and] got buried. The other workers removed the mud and managed to save him. They took my husband to the hospital. Now when trying to work he faces a lot of problems. He has pain coming from two sides of his belly and sometimes when he coughs, blood comes out of his mouth' (Woman, aged 40) (Ayeb-Karlsson et al., 2016).*

Many indicated that rural-urban migration led to worsened diet and food security, living conditions, education opportunities, and social support networks (Ayeb-Karlsson, 2021; Ayeb-Karlsson, 2020). One woman described the challenges of moving with her family from Bhola island to Dhaka:

*'We now struggle with hunger . . . We have to leave our pride behind and beg for help from others. If I had stayed on Bhola Island, if I still would have my land and house there, I would be all right today. Our living condition would be better and our children would have ended up being highly educated' (Woman, aged 40) (Ayeb-Karlsson et al., 2016).*

Others expressed concern that children, who left their homes and schools when their parents moved to urban areas or for temporary work, were exposed to unfamiliar diseases and health risks. Some said there are 'many opportunities to ruin your life in Dhaka city' via early marriage and motherhood among girls, interaction with the 'wrong crowd', and exposure to drugs and tobacco.

Some participants who migrated from villages to urban centres experienced threats to psychosocial health via disrupted socio-cultural contexts, including: reduced social value and honour of women, and loss of belonging and place attachment. Hard labour among women was considered to reduce status and honour. As one man stated, 'women are working outside the house and going here and there. This is not good' (Ayeb-Karlsson et al., 2019). Further, many who had moved to poor urban settlements said they were unable to migrate as they lacked the resources to move to another site despite ongoing exposure to climatic, environmental and social risks; this led to adverse consequences for mental health (Ayeb-Karlsson, 2021; Ayeb-Karlsson, 2020). People recalled that life on Bhola island was better, happy and peaceful, and that their land (before it was lost to the river) had provided food security and self-sufficiency. By contrast, people spoke of feeling depressed, sad, anxious and stressed in Dhaka. One young man explained 'I have lived in Dhaka for more than ten years now, but I do not like it here. Dhaka is not my place . . . here it is difficult to pass each and every day' (Man, aged 20) (Ayeb-Karlsson, 2021). For some, their recollections of places of belonging and traumatic histories of environmental hazard, contributed to lasting challenges to mental health:

*'I feel the breeze coming in from the sea, and it forces me to remember. I cannot stand that breeze anymore . . . I am the only one who survived from my family. I survived, but my head and my mental wellbeing did not. I am not stable. When a person faces such a tremendous loss, he ends up frustrated. All my four children and my wife died. I am the only person left alive. How could I possibly be mentally stable? I have fallen apart' (Man, aged 38) (Ayeb-Karlsson et al., 2016).*

In sum, migration reportedly affected both physical and mental health. Those involved in labour mobility described poor living and working conditions, particularly women who lost social status when working outside the home. Trapped and displaced migrants in urban settlements faced health risks due to dangerous work and living conditions and, for some, loss of place attachment and belonging.

#### 4.3. Burkina Faso: seasonal labour mobility

In Bourasso, first time labour migration was reported to have mainly negative health consequences for both mobile men and the families they left behind. Burkina Faso (pop. 19 million) is landlocked; the economy and people's livelihoods depend heavily on rain-fed crops and livestock production. Bourasso, in the north-west, has approximately 3,500 residents who are mostly farmers. Participants report low and unpredictable rainfall, drought, poor harvests, food insecurity, and inadequate income in recent years. Seasonal out-migration emerged for the first time in living memory, as a pathway for livelihood diversification and to cope with food insecurity. As one man said:

*'It's misery [that made us migrate], it did not rain well and the famine was so strong, and needed food so badly. And then this man came to us telling us that he was looking for people to go work, so we did not hesitate a little bit to follow him and go there'* (Man, aged 20) (Vinke et al., 2021).

During the agricultural off-season, some men migrated to the Ivory Coast and Mali to work on sugar cane plantations and in gold mines, staying on average for four months. Women and children stayed behind and tended crops. Prior to migration, it was anticipated that seasonal out-migration would provide alternative livelihoods and income sources during times of environmental stress and food insecurity. However, participants reported that out-migration posed threats to health, both for migrating men and for women and children who remained.

Men expressed dissatisfaction with the lack of financial gains afforded through seasonal work, harsh and exploitative working conditions, and health problems. Several men reported that they experienced workplace injuries and many (n=16) said they contracted malaria:

*'The fever, because of tiredness, often the more you work without having a rest, the muscles don't function correctly anymore, as the body can't bear it too. Apart from that and the stomach-aches, and malaria, there is nothing'* (Man, aged 27) (Vinke et al., 2021).

The inadequate income from their hard their work was reportedly not sufficient to survive, save money and send remittances home. Further, many participants reported experiencing fraud and theft. For those men who did save some income, it was generally less than anticipated and did not compensate for harvest losses in Bourasso, experienced due to their absence. Nonetheless, most participants said they would likely participate in future seasonal out-migration if bad harvests persisted, given the lack of other income sources and food insecurity.

Wives of seasonal out-migrants reported the challenges of being left behind in Bourasso. While they continued to earn income – e.g. through farming, housekeeping, and beer brewing - they explained they had no money to purchase food and essential items, experienced continued food insecurity, and had to manage the caring of children on their own. These women were very concerned about their children's health, particularly given the ongoing challenges of providing adequate food. Several women were also worried that their husbands might return with sexually transmissible diseases, including HIV. While some women said they would not encourage their husbands to engage in seasonal migration in the future, others said they might have no choice particularly in contexts of food insecurity. As one woman said, *'If he chose himself to go back and suffer to earn a living for the family, I can't stand against it. I would accept if there is no food in the family'* (Woman, aged 32) (Vinke et al., 2021).

While seasonal out-migration has the potential to provide an adaptive response to environment-related risks via livelihood diversification, this case study questions the adaptive potential. The Bourasso experience highlights that seasonal labour migration does not necessarily improve livelihoods and income sources during periods of environmental and climatic stress. Further, beyond livelihoods, there are health risks both for those who move and those who remain in place. Moving beyond the binary positioning of migration as adaptive or maladaptive, the case study highlights the trade-offs, opportunities and risks that migrants and their families face during seasonal out-migration.

In sum, in the context of irregular rainfall, extreme heat triggering mini-droughts and poor harvests affecting food security, Bourasso residents engaged in first-time seasonal migration in search of diversified livelihoods and with the hope of sending remittances home. However, both migrating men and the wives they left behind perceived migration to have negative consequences for their socio-economic situation and health. Food security did not improve at home, women feared infections being introduced by returning migrants, and men endured injury, infection and exploitation. Despite this, both migrating men and their wives would consider future seasonal migration given environmental pressures, threatened livelihoods and lack of alternative options.

#### 5. Discussion and conclusion

In a warming world, human mobility entails diverse health opportunities and risks. In the examples above, we examine health impacts associated with: planned relocation away from a site of coastal risk (Fiji); (im)mobility and livelihood diversification across climate-vulnerable sites (Bangladesh); and seasonal labour migration in response to drought and food insecurity (Burkina Faso). These case studies contribute to the small body of empirical evidence of risks (and some benefits) to health in contexts of climate-related (im)mobility: e.g. altered diets, compromised access to health care, loss of income, risky working conditions, unhealthy urban environments, altered infectious disease exposure, disrupted social networks, and loss of place attachment. The health of these populations is not determined solely by environmental risks, but is shaped substantially by socio-political and economic contexts as well as individual and household characteristics (Schwerdtle et al., 2020).

Residents attribute local environmental changes (e.g. drought, coastal flooding, coastal erosion, riverbank erosion, altered rainfall) to climate change, and regard these climatic changes and associated impacts as a catalyst for migration and mobility. Even where these perceptions of climate risk do not precisely match scientific climate and environment data, and noting that scientific data on climate risks are not necessarily available at the relevant community scale, these perceptions of climate risk are central to decisions around migration and mobility. Nonetheless, while people across these case studies refer to climate change risks we do not suggest these are straightforward examples of climate migration. There are well-documented problems with the concepts of 'climate refugees' and 'climate migration' (Van Praag et al., 2022; De Longueville et al., 2020; Fröhlich, 2017). Migration decisions are irreducible to climate change; they are shaped by pre-existing migration pathways and economic, political, historical, demographic, social and environmental factors that interact with biophysical climate risks (Baldwin et al., 2019; Barnett and McMichael, 2018; Piguet et al., 2018). Further, climate change will often act as an amplifier of existing migration, rather than creating new types of 'climate migrant' (Funk et al., 2020). So, we argue that in considering the connections between climate-mobility-health, it becomes less important to establish the health risks for climate migrants, and more important to consider the health needs of people on the move, and who are unable or unwilling to move, in a warming world.

The planetary health lens foregrounds forced displacement in response to climate disaster and the expectation of risks to health among climate migrants. The planetary health narrative is compelling and concerning, whereby climate change pushes some people from their homes and traps others in risky locations, with escalating threats to human health. There is interest in discerning the 'excess' migration driven directly by climate change, and the specific health risks of climate-related migration. Within this framework, accounts of climate-related displacement and migration often suggest exceptionalism, with the assumption that climate-related migration will be distinct in scale and nature from other existing forms of migration (Bettini, 2013).

However, the widespread expectation within planetary health of large-scale displacement that can be attributed to climate change threats

- the climate refugee narrative – obscures the current and complex experiences of climate-related mobility. As the case studies above highlight, climate-related mobility takes many forms including planned relocation and migration away from sites of climate risk, displacement following environment- and weather-related disaster, temporary labour migration to diversify livelihoods; and some people are immobile or trapped in place following climate-related mobility, or are ‘left behind’ and remain unsupported in sites out-migration. A key contribution of this paper is to examine some of the diverse ways in which people move both from and to sites of climate risk in a warming world, and to consider associated consequences for health. It responds to calls to document, through empirical research, and better understand the complex connections between climate change, mobility and health (Schwerdtle et al., 2020).

What does this mean for action on climate-related (im)mobility and health? First, while climate-related mobility can provide an adaptive pathway, climate change mitigation and adaptation strategies are required that enable people to remain in places of belonging (Felli and Castree, 2012). Second, where adaptation has reached its limits, and where failure to act effectively on climate forcing contributes to continued global warming with escalating risks, people may move both from and into sites of climate risk. Rather than developing frameworks to address the health of a new category of ‘climate migrant’, resilient and inclusive health systems are required that reduce access barriers for all migrant, mobile and displaced populations. Additionally, there are multiple dividends from addressing determinants of health through context-specific planning and climate adaptation, including investing in climate resilience and foundations for health in cities and peri-urban settlements. Third, there is increasing imperative to address human mobility in climate change action and adaptation plans, such as climate-related planned relocation policies and disaster displacement responses. There are many frameworks – globally, regionally, nationally – that have started this work, some of which address the health of migrants in a warming world. Key principles are enabling migrant participation in identifying and addressing their needs, promoting human rights including the right to health, and facilitating migration as adaptation to expand the choices available to individuals and households (Stojanov et al., 2021). In sum, it is necessary to promote and protect the health of people affected by diverse forms of (im)mobility in the context of climate change.

Nonetheless, as Baldwin warns, we cannot reduce climate anxiety by positioning environmental migration as an issue that can be readily defined, identified and managed (Baldwin, 2017). The diverse case studies we present underscore that there is no archetypal ‘climate migrant’ that can be slotted into frameworks for planetary health. If we anticipate risks and tipping-points signalled by large-scale population displacement we obscure diverse forms of climate-related (im)mobility – such as small-scale planned relocations, seasonal labour migration, rural-urban mobilities, and left-behind or populations – that require solutions to protect and promote health.

#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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